APRIL 1960 3s. 6d.

AUTOMATIC DATA PROCESSING

JOURNAL OF MANAGEMENT AND INFORMATION SYSTEMS

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Imaginative uses for computers

The production-sales cycle at Heinz

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Comment

ENDS AND MEANS

THE American Management Association held its sixth annual conference on data processing during February. One of the principal speakers was Mr Milton M Stone, who, in the course of his address, made a point of such fundamental importance and transparent simplicity that it is somewhat surprising that it has not been widely assimilated in British industry.

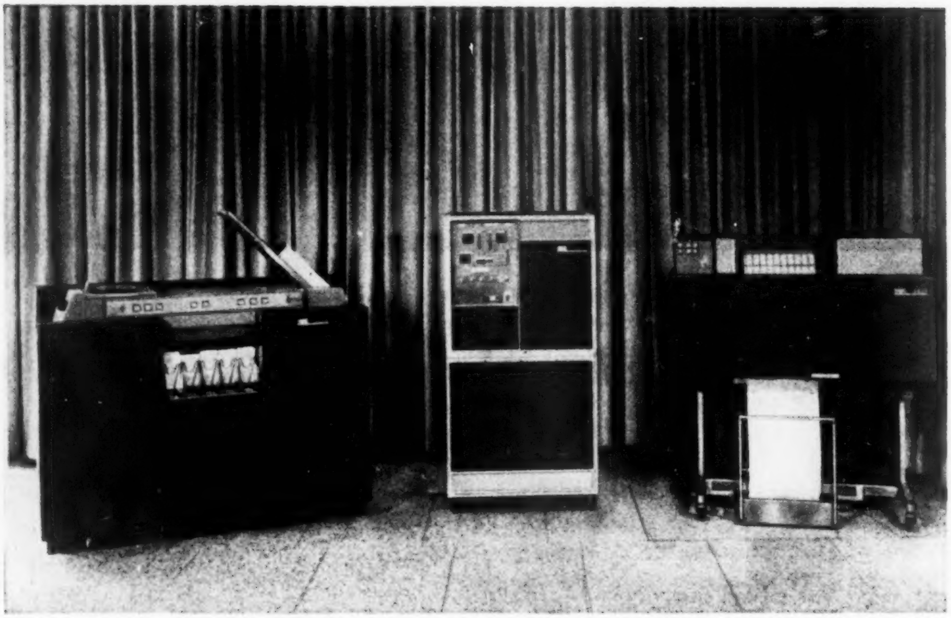
'We should keep clear the distinction between *data* and *information*', Mr Stone said. '*Data* are a group of facts or statistics that are undeveloped, uninterpreted and, too often, unread. *Information* is knowledge derived from the effective organisation of data.'

This is a necessary and very welcome definition. It is a very common experience of those—whether consultants or journalists—who enter firms to analyse and review business systems to find, on the part of accountants, organisation and methods managers and others in the middle strata of managerial functions, an astonishing inability to comprehend the totality of the business systems that they are charged with operating.

One reason, the prime reason, for their failure to see the wood for the trees is their confusion of ends with means. Absorbed in the routine technicalities of data processing they lose sight of the object for which data are being processed: the supply of *relevant* information where and when it is needed.

The matter goes much deeper. It is an aspect of the problem of specialisation of function, a product of the technological era that we have not yet been able to solve. The ability to see a system clearly and to see it whole is not a gift within every man's grasp. In the complexity of contemporary organisational life the need for a high order of intelligence is greater than at any time in our history. Yet one still hears, at conferences devoted to managerial problems, the ragged cliché that there is no place for 'the genius' in business management. How long are we to continue to prefer mediocrity to intelligence? And where will this obstinacy land us?

success story



Five months ago we announced an entirely new small computer with very fast input and output—the IBM 1401 Data Processing System. We were certain that many commercial organisations needed a machine that would bridge the gap between the normal punched card system and the large-scale computer. And we were right.

To date, over 30 machines have been ordered.

The first will be installed in 1961.

IBM

Business and Scientific Computing

—The Inevitable Marriage

The previously distinct fields of scientific computing and business data processing will come closer together as the new powerful and obviously 'dual purpose' computers come into their own. As this will entail co-operation between technician and systems analyst, the basis for this might well be worked out now.

Ralph Weindling

As if there were not enough already, a new problem of company-wide scope is quietly developing in the field of data processing and engineering and scientific computing. The problem concerns the relationship between engineering computing and business data processing in actual practice and in organisational structure. So far the problem is being experienced only by the larger companies, but it will soon be one to be faced by the medium and smaller firm as well.

Just when a comfortable separation between business data processing and scientific computing had begun to establish itself, two developments have, in a very real way, raised the question of whether and to what extent the two should be brought together again. These two developments are the characteristics of the new equipment for computing and data processing, and the growing complexity and sophistication of certain business data processing applications.

Computers were first developed to solve scientific and engineering problems, and a significant proportion of computers in use today is still devoted to fulfilling technical calculation needs. Automatic data processing got its real start when machines were developed to meet the demands of commercial data processing activities, which required far more sorting, larger files, and speedier input and output characteristics than scientific problems. In compensation, it was possible to sacrifice computing speed in computers for commercial data processing.

DEVELOPING COMMERCIAL USES

Among the many immediate problems that came to light was the need to take some computing and computer functions out of the hands of the technical people so that business applications could be fully developed. The difficulty was compounded by the fact that of the few computer technicians and programmers available, most had their background in the technical use of computers. The breaking away of business computing from technical computing gave rise to certain organisational problems, although these were made somewhat milder by the simple fact that computing machines in general were so new that there was a minimum of built-in organisational rigidity. Furthermore, the existence of computers for technical functions was never thrown in doubt, and those in charge had more than they could handle in trying to meet their own problems. The resulting development of computer organisation was a rather clear separation between 'computing' and 'data processing,' each group tending to its own business. In certain industries, notably oil

refining, the separation was at times somewhat blurred, because the refinery calculations were closely related to the business side.

FUNCTIONS MERGING

Developments in equipment and progress in applications have both caused management to reflect whether the separated structure is the most effective organisation for the long term. New equipment is now available, and more is under development, which has the characteristics to handle both data processing and scientific calculations, so that one of the main reasons for the initial separation disappears.

The IBM 7090, the Honeywell 800 are just two examples of machines whose specifications for internal speed and logical ability suit them to technical work and whose data handling abilities also qualify them for business data processing. But there is a more positive factor than merely the elimination of one of the reasons for the initial separation between scientific computing and business data processing. Many companies find that the only way in which they can afford one of the new larger machines is through a combination of these functions. Further, any calculation clearly indicates that, per dollar spent, the value received in calculating and data processing ability increases at a phenomenally fast rate as one goes from the small to the medium scale to the large scale machines.

A company with an IBM 705 devoted to business data processing and a 704 devoted to engineering calculations can easily get more than five times the computing-data processing capacity per pound spent with one IBM 7090. The attraction is a strong one in itself, and it is accentuated by the fact that a great many more applications become justified when the economics of the situation are thus changed. In other words, whereas it may not have been justified to obtain a second 705 for marginal applications, the cost structure of a combined operation would permit their being undertaken. In many cases, these are not fringe applications alone; they may be just those whose intangible benefits are the real gain from automation but which cannot be justified on a hard savings basis. These factors are by no means confined to the giant companies and the giant computers. They may even apply with more force to the medium size firm that cannot justify any type of advanced computer for either business data processing or scientific computing alone, but could afford one under a combined situation.

Growing sophistication in certain business applications is another factor that raises the question of a closer relationship between the two computing functions. A payroll application requires straightforward programming, and the amount of mathematics or technical knowledge required is minimal. The same may be true of a straightforward inventory record-keeping situation, but the requirements change when one goes to an integrated system for production planning and inventory control, with automatic calculation, on a continuing basis, of order quantities, economic lot sizes, scheduling patterns, and allocation of factors of production.

The programming, and even the system design factors, that are involved in such a system are much more akin to some engineering problems than they are to a payroll application. In fact, they contain elements of both, and in many companies with both scientific and business computing activities within talking distance of each other, there has been a good deal of informal co-operation. Scarce manpower in this field is another reason that it is impossible to duplicate skills in each functional area even if the company were willing to afford it.

OPERATIONAL RESEARCH

So-called operational research activities are just another example of the problem. Operational research is often defined as the application of the scientific method and scientific techniques to the solution of business problems. If this is a bad definition, it at least sums up the procedural and organisational difficulties that can result.

Operational research is applied to business problems. In many cases, these problems require the 'scientific' type of computer for solution, and they in all likelihood require many elements of the programming and mathematics that is commonly found in a scientific computing activity. Where, then, does the operational research function fit in the company—in the business data processing activity where the talent and equipment for certain problems are not available or in the scientific computing area where business knowledge, let alone interest, does not exist? The problem is complicated in that much of what is often considered the operational research approach is often profitably built into a data processing system.

At the present time, there is obviously no clear pattern, for the problem has just recently developed, and the equipment that contributes to it has yet to be installed. But interest and concern in the problem are widespread. At a recent computer meeting a John Diebold & Associates staff member suggested the topic for discussion and promptly found himself Chairman of a room overflowing with people who had elected to take part.

ACUTE PROBLEM

In some of the firms in which engineering computing has been thoroughly developed, notably the aircraft companies, the problem is the most acute, both in its effect on the organisation and in

its immediacy. One company has constantly subordinated the business data processing function to the engineering, with the result that the business function has been almost completely neglected, and the morale in that activity is at a low point. In another aircraft company, one of the most advanced in the use of computers for business and engineering, the entire computer operations are co-ordinated through the controller. His office controls equipment acquisition in much more than a pure budgetary sense, and it is one of the few examples where a combined activity has really taken hold.

The plans for data processing and computing organisation of another of America's largest companies call for continued separation of the two functions, with periodic review and reconsideration. One of the anomalies of this decision is that operational research activities are to be handled in the engineering computing group, as is programming for numerical control of machine tools.

An oil company now has a structure in which computer operations, to the extent that they are centralised, come under the control of one man, who concerns himself with business and technical computing machines. But he does not have control of the preparation and programming of business applications. However, he and those concerned with business application development all report to the controller's office.

HARMONIOUS OPERATION

In many of these organisations, the tendency has not been toward a further separation of business data processing and computing. On the contrary, the tendency has developed in the opposite direction, with recognition that there are significant problems in achieving a harmonious and effective combined operation. Some of these problems are procedural and some are concerned with personality factors. Business data processing generally has a strict schedule to follow with specific deadlines, while scientific and engineering computations are generally demanded 'as soon as possible.' Such a situation, together with the tendency of scientific computation requirements to peak at irregular intervals, causes scheduling difficulties in a combined installation. Machine breakdown obviously intensifies the problem.

A similar problem of allocation of time can arise in the analysis and programming activity especially as the business applications begin to require some of the skills that are associated with the scientific programmers. However, it is reasonable to question whether the allocation of these scarce resources is more of a problem under a combined installation than when each group goes out to try to hire on its own.

Probably the main reason for reluctance to bring the two activities closer together is the feeling that engineers or technical people on the one hand, and businessmen on the other hand, just do not think alike, and that personality differences would make smooth operation quite difficult.

THIN DIVIDING LINE

In this context, it is clear that as automation in general, and in the data processing field, develops further, there will be increasing demands for co-operation between so-called technical people and business people. In many cases the two qualities will have to be merged in one person, a requirement that more and more businesses are already beginning to feel. In a fully automated factory, there is a very thin line between production planning and scheduling (a business function that would be considered business data processing) and the actual setting in motion of the physical production process, a function that in an automatic plant is becoming more and more that of the technician.

The use of numerically controlled machine tools is an example of the necessary blending of different characteristics. The design of the part to be made is an engineering function that must be closely co-ordinated with manufacturing's need to utilise the tools effectively. The design of the jigs and fixtures to be used in manufacture, and which are generally also made on the tape controlled machine tools, demands similar co-operation.

Finally, the programming of the parts and tool production is generally done by technical programmers, so that the entire process requires extremely close co-operation between manufacturing and engineering. When a data processing system is developed in the company, it must take account of these capabilities so that the system can contribute to proper planning for the use of these machines.

There is no reason that a company that is starting a data processing automation programme should complicate its problems by immediately attempting to bring engineering and business computing together organisationally, and for many years to come there will be many firms that will continue to keep the functions separated, either because there is no reason for bringing them together or because the effort is not worth the resulting benefits. However, the new equipment that has appeared and will continue to appear does make this joint operation a real possibility. The advantages and disadvantages will vary in each company. However, those firms that see an advantage in such joint use of equipment and some form of organisation must lay the groundwork long in advance of the actual merger, so that there can be gradual progress towards it.

Names and Notes by Robot

The Original Pioneer Speaks

THE Metropolitain Life Insurance Company of New York is the largest life insurance company in the world (an indication of this is the total of six million records kept at its New York office), and as it achieved the distinction of being the first company anywhere to instal a computer for commercial purposes when it bought a Univac computer in 1954, the British Computer Society scored a scoop when they got the third vice-president of Met-Life, John J Finelli, to speak to them recently on the company's computer experience.

Not only have Met-Life lived with a computer since 1954—they quickly invested in more computing capacity, so that today they use three Univac systems and have a fourth on order.

For some time ahead I can see that manufacturers and computer users will be swopping some of the things Mr Finelli said because his is a success story.

On economics—the aspect that kindles attention quickest—Mr Finelli intimated that Met-Life's experience showed two important lessons:

1. When taking over the fairly large operation done with electro-mechanical punched card equipment (or possibly with an electronic calculator) the computer should be able to reduce operating costs by 50 percent. This assumes that there have been no radical changes in procedures.
2. Where a fair amount of systems engineering is done, and the procedures are changed to suit the new equipment, it would be disappointing if operating costs did not fall by a further 25 percent.

A further thought the vice-president offered was that a user should get a return of 70 cents per annum for every two dollars invested in equipment (*ie*, a return of seven shillings for every pound invested).

On costs he stated as a fact that using conventional punched card equipment it costs about 90 cents per 1,000 cards to do a 12-digit sort of 80-columns cards. With a machine of comparable performance to Univac 2, the same sorting operation would cost as much as 1 dollar 64 cents. This demonstrated that the first generation of computers was not particularly efficient on some operations like sorting. However, with the new types of equipment now being offered by American manufacturers, the cost of the 12-digit sort would be reduced to 40 cents per 1,000 cards. This would offer more scope to programmers and systems engineers as in the past they had had to take much trouble to avoid computer sorting when designing procedures.

Mr Finelli gave other comparative costs for jobs that might be done by punched card equipment, current computers and 'second generation' systems, and in the course of his short 'ex tempore' talk touched on other topics such as the high cost of systems study (' not necessarily more expensive than developing any other type of procedure change') and the use of magnetic tape.

Asked whether there would be 'any future' in random access storage in view of new tape speeds, Mr Finelli replied that the battle between random access and serial access was still unresolved. Much depended on the extent to which 'real time' processes (such as airline bookings) were developed. For in such applications random access was important. But whether it would be useful in the 'paper business' was not clear. The speeding up of serial searching techniques might be adequate for that.

Card-sharping—New Style

LAST month a report in the *Financial Times* gave an account of the first (first discovered, that is) 'embezzlement by electronics.' A member of a Wall Street firm is alleged to have diverted 250,000 dollars of company money into his own personal brokerage accounts, and this was done by skilfully

altering punched cards. It has taken eight years for the firm to uncover what happened, and even after the discovery, investigators had to spend several weeks tracing exactly what happened.

I recall that last year at the British Computer Society's Cambridge conference, the subject of auditing data produced out of a computer was discussed, and one speaker pointed out that most frauds have been perpetrated by exceedingly clever men, and that was a good enough reason for giving auditors certain safeguards — for example, a copy of the program to be kept locked away but run through once a year to enable the auditor to compare his program's results with those produced by the computer department. I don't recollect that these remarks were taken very seriously at the time, but they might be now.

For the Man in the Street

On display behind a large shop window in London's Aldwych is a Stantec-Zebra computer, which Mr J Read, Publicity Manager of Standard Telephones and Cables managed to 'borrow' for his own purposes.

These are quite unsinister: Mr Read wants to give the man in the street an idea of what an electronic computer looks like, and at the same time give some notion of what ST and C do— 'everyone knows we make telephones and cables and now they will know we make computers.'

This display encourages 'spectator participation' with a device (a photo-electric one, I suspect) for starting up the computer from the street; once started it proceeds to solve some equations which are printed on a large board. Then, suggests Mr Read, if the man on the pavement wants to go home and check them he can—also he can see how long it will take him to do so.

Will the show window, I wonder, produce any 'impulse buying?'

Computer Centre for the Midlands

By installing one of their 1202 computers in their Birmingham service bureau, ICT become the first computer company to invade the Midlands with a time-hire service (apart from English Electric, the 'native' company whose computer centre was recently moved from Stafford to Kidsgrove).

ICT, who have refrained from entering the time-hire business in London (their London computer centre was mostly devoted to demonstrating their machines to would-be customers, or running programs for customer-organisations), estimate that the bureau will now attract the small and medium-sized firms who predominate in the Midlands, and whose volume of data processing work would not justify a computer, but who would be keen to hire time for production control routines, in particular plant loading ones. In fact, the company will be demonstrating this type of computer application in a series of 'open days' at the bureau.

Hire charges will be at the rate of £25 an hour, and programming charges will be £2 per hour of programmer effort.

First Order for a Cheque Sorter

Demonstrated for the first time in London recently was the Burroughs document sorter * which will sort documents such as cheques at speeds of up to 1,560 a minute—in fact, of the sorters so far available it is the fastest.

Burroughs were able to announce at this demonstration that Lloyds Bank had ordered one of these sorters. It will be delivered in 18 months' time and will cost the bank some £35,000.

The sorter operates by reading data printed in magnetic ink on documents (an article on this subject—character recognition—begins on page 23 and Burroughs say that people other than bankers have shown considerable interest in the company's sorter and associated equipment. One does not have to search very far to uncover the reason why.

As the equipment sorts (and reads) magnetised characters, it is capable of transmitting what it picks up directly into a computer system. This means that printing in magnetic ink becomes another input medium for computers, and as such could quickly rival punched cards and paper tape (magnetic tape as a direct input medium is still a non-starter), and could give rise to a family of equipment that would compete with punched card equipment.

Out with the Old

The Southern Railway Company, whose systems were reviewed in 'American Report' (see February issue), are going to throw out their IBM 705 computer, and introduce instead an IBM 7080 system, a new complex recently announced in the USA. Principal features of this new giant are a 2.18 microsecond access-time to any of up to 160,000 characters in a main memory store, and the ability to transfer a character from tape to main storage in 1.09 microseconds. Also it takes up less space than its predecessors.

* *The sorter was commented on in the August/September 1959 issue of* Automatic Data Processing.

The Production-Sales Cycle at Heinz

THE essence of a successful data processing installation is, quite obviously, the care that goes into planning the system. Mechanisation by itself solves no administrative problems; but it has the incidental advantage that it enforces effective organisation. The more highly mechanised the system, the more efficient its planning must be. These simple facts are fairly generally recognised, and interest in the details of 'organisation and methods' or 'systems analysis' is widespread. This brief account of how the H J Heinz Company forecasts sales and controls production of its famous 57 varieties of food preparations is an attempt to appease some of this hunger for information.

The figure of 57 Heinz varieties is an arbitrary one. When all the different sizes of package are taken into account the true number of items in the inventory is about 190. The various products are prepared and canned (or bottled) in three factories and they are distributed to the grocery trade from 30 warehouses in Britain.

The whole problem of planning production and sales may be expressed as the problem of keeping in these warehouses at all times the minimum inventory that will satisfy the demands of the market. If too few stocks are held, sales will be lost to competitors and profits will decline; if too many stocks are held, a disproportionate amount of the firm's capital will be unprofitably tied up.

The H J Heinz Company believes that the working capital of many firms is dominated by the inventory: in other words, there are too many goods, representing money, sitting for too long on warehouse shelves. It is this undesirable, uneconomic state of affairs that every company tries to overcome in idealising or 'optimising' the correspondence between its sales and its production. It is this type of problem for which a large number of automatic data processing programmes are written.

PLANNING PRODUCTION

The H J Heinz Company employs a planning and distribution department to reconcile sales forecasts and production schedules. The department plans production schedules on an annual basis, revises the forward plan each month and adjusts the production schedules as often as necessary, perhaps weekly. The annual plan is revised and consolidated each quarter.

In order to produce an effective plan and to keep it up to date it is necessary to have a continual flow of reliable information from two main sources: on the sales side it is necessary to watch the fluctuations of the market, and on the production side it is necessary to know the availability of raw materials and the capacities of the factories to use them.

CENTRALISING SALES DATA

The sales information comes from the company's representatives through the sales managers in the 30 distribution areas into which the country is divided strategically for the best distri-

bution. Each salesman has hundreds of customers on whom he calls monthly. The warehouses deal with about 5,000 orders every day, with an average of ten items to each order.

Until quite recently, orders were passed by the warehouses, after shipment, to the local sales branch offices for invoicing, statistical analysis and posting to customers' ledgers. Now, however, about half of all orders covering the midlands and southern England are dealt with through a centralised IBM punched-card installation in London. These shipped orders are now sent to London, where punched cards are selected from pre-punched banks of the subsequent production of invoices, sales statistics and ledgers. One card is selected to cover the customer's name and address and others to cover each variety. Thus there will be, for example, six cards for an order involving five varieties.

The first run through the IBM machines produces invoices—only one copy, which is then microfilmed for records—and summary cards, which are filed in order of customers. The variety cards are then sorted and tabulated to produce sales statistics of each variety. They record quantities sold, prices, discounts allowed and values, from which complete statistics are compiled. On these statistics are based the estimates for future sales which will contribute towards determining the production schedules.

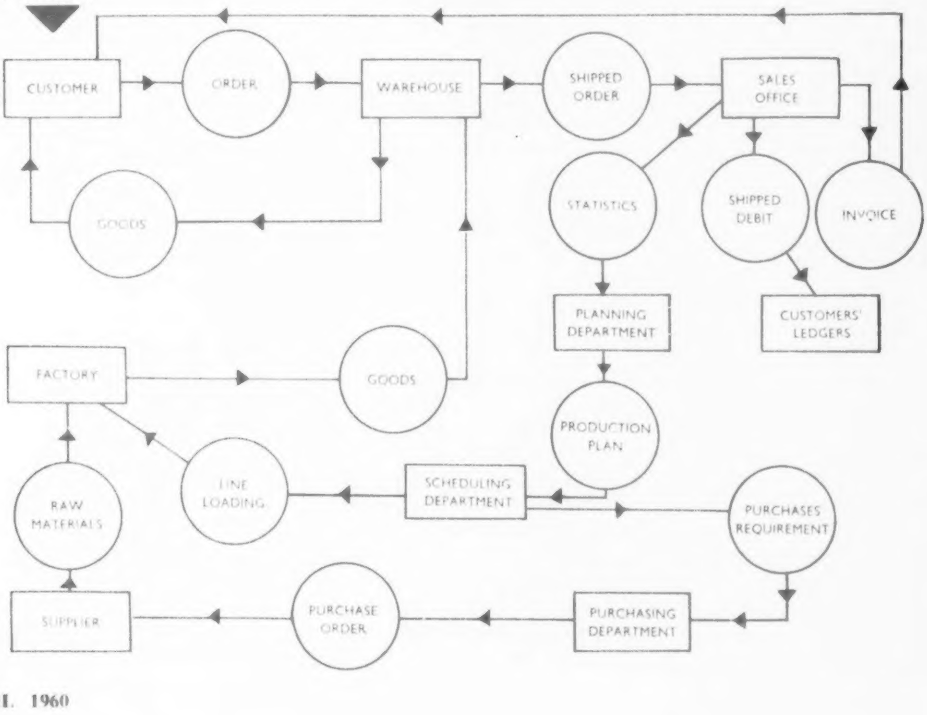
ADJUSTING PRODUCTION SCHEDULES

If in any month sales exceed the forecast, the production schedule is adjusted for the following month. Modifications may also be made to the production schedule at shorter intervals. Obviously major alterations to the production schedule cannot be made at short notice, as the purchase of many of the raw materials has to be planned some time ahead. A firm production programme usually covers five weeks. At the same time, long-term adjustments to the production plan *are* made at frequent intervals, based on assessments of the trends in sales and other factors. Broadly speaking, a fresh annual production plan is produced every three months, and it is under constant re-appraisal and revision.

ALLOWANCE FOR FLUCTUATIONS

There are seasonal fluctuations in the supply of vegetables and seasonal fluctuations in the demand for certain kinds of foods. Both these factors can weigh heavily on the shape of the annual production plan. Tomatoes, for example, have to be processed during the months in which they are abundant and of good quality. At such a time, when there is heavy production of one item, the warehouse stocks of other items have to be high enough to compensate for a period of low production. As any one of the food products of the company may contain a dozen or more ingredients,

ALL ROADS LEAD TO THE CUSTOMER a graphic illustration of Heinz's activities.



many of which can only be obtained at certain seasons, it is apparent that the planning of production and the maintenance of economic inventory levels presents complex problems.

Naturally, the can manufacturing schedules have to match the food schedules, and both involve carefully calculated anticipation of the supply of raw materials. An order for tomatoes, for example, has to be placed about eight months ahead; but estimates are constantly revised and brought up to date. Crops may be disappointing in quantity or quality, prices may fluctuate unexpectedly, strikes may affect the transport of raw materials, and a dozen other factors may affect the production schedule at any time.

The object of the production schedule is to supply the customers with the goods they need. An essential step in the process is therefore the organisation of distribution. Goods are sent out to each of the distributing centres to match the sales estimates for each centre. Stocks adequate for the following four or five weeks are replenished weekly.

TYPICAL PROBLEM

The pattern outlined in this article and set out in schematic form in the accompanying diagram is fairly typical of the problem facing many manufacturing companies today. It is apparent that the enormous number of variable factors that must be taken into account makes some form of automatic data processing almost an essential, if realistic production schedules are to be maintained and optimum inventory levels achieved which, whilst meeting sales requirements at any time, will also minimise costs.

The BIM Glasgow Conference

Stephen Rose writes: Far and away the most interesting feature of the BIM's one-day conference on computers in Glasgow last month was the Unilever film 'The Electronic Computer in Commerce.' This first-class production, which has already had a wide showing, makes interesting viewing even for people who are well acquainted with computer techniques. As one delegate told me: 'It is extremely helpful to get right down to basic facts again once in a while.'

By contrast, the ICT film 'Time to Think,' which was used to dispel post-prandial somnolence, appeared artificial and unconvincing. It does a less effective selling job for computers than Unilever's non-commercial effort.

Of the speakers, D T Caminer, chief consultant of Leo Computers, made the most useful contribution. After reading a sound paper on 'How to Make an Appraisal' he dealt most informatively with a number of searching questions from the audience.

Mr Caminer admitted that firms with under about 2,000 employees were unlikely to find a computer economic and went on to discuss the alternatives: shared installations and service centres. He revealed that two Scottish insurance companies would soon be the first in Britain to share a computer, but he emphasised the practical difficulties inherent in such a project—joint operating staff, allocation of operating times, and so on.

On service centres, too, Mr Caminer was less than enthusiastic. He admitted that, judging by experience in the United States, service centres would eventually provide a practical solution for the medium-sized concern. But he pointed out that computer manufacturers would be chary of investing about £200,000 worth of equipment and other capital sums in such centres without any guarantee that the installation would be adequately patronised by local firms.

'Will equipment become cheaper?' one delegate wanted to know. Mr Caminer thought not. He pointed to the price-tag of about £800,000 on the latest IBM model in the USA—an all-time high. There were, of course, cheaper computers coming on to the market, but unfortunately they could not do so much as the more expensive equipment and their use was often rather limited. On the other hand, the smaller firm's operations are usually just as complex as those of a larger concern, especially in engineering, so that it was doubtful whether cheaper computers would find wide-spread application on commercial work.

The BIM's star turn for the conference was John Diebold, who spoke against an obbligato of sad fiddles that filtered through from a *thé dansant* in the next room. Though he was billed to speak on 'A Review of Recent US Applications' his paper in fact dealt with 'Computer Developments During 1959.' But he made amends for any disappointment his audience may have felt with a number of sparkling anecdotes, at least one of which is probably still doing the rounds in Scottish pubs.

Abstracts from some of the papers read at this conference will appear in the May issue of AUTOMATIC DATA PROCESSING.

Winding up the Study

P T Bridgman *Urwick Diebold Ltd*

Last month's article considered the selection and study of possible application areas. The next phase is to show how the information obtained in the study is used to design a broad data processing system, and how the estimated cost of this can be compared with cost of existing methods to formulate the case for or against the use of automatic data processing.

ONCE areas of work have been studied in detail they should be related to each other to reveal the possibilities that might exist for rationalising and integrating. The main economies of automatic data processing systems arise from integrating routines: the same input or filed information is used to perform, in the same sequence, operations dealt with separately in existing systems. The ability of computers to deal with more than one record at the same time facilitates the consolidation of routines.

It is unlikely that in the preliminary grouping of areas all opportunities for integration will have been discovered and this stage of the study provides a check on the initial grouping.

Closer examination of the detailed routines at this point may well reveal opportunities for integration which were obscure at the earlier stage. Input, filed information and output can be systematically compared by using a chart such as the one below. Items of data are listed vertically and columns are provided for the different files and input containing the data. Crosses are inserted in the appropriate columns. The crosses appearing on horizontal lines will indicate the frequency of occurrence of the various data in the system. Instances of duplication of input or the input of data already contained in a file will become clearly apparent.

Data Comparison Chart

	Customer Data File	Sales Data File	Daily Order Input
Customer Code	×	×	×
Customer Name	×		
Customer Address	×		
Representative	×	×	×
Terms	×	×	×
Govt. Standard Reg.	×	×	

Also, rationalising the output in the same way, apart from assisting in the design of the automatic data processing system, may show duplication in the existing reports and statistics, which could be eliminated.

COSTING THE PRESENT SYSTEM

Detailed costs must be established for the present system, in addition to estimates of the cost of providing for the additional management needs which have been specified. Some assumptions will probably have to be made in arriving at these estimates. It is usually convenient to compile cost data when a detailed study of the areas of clerical work is being done. The costs will be the present costs reduced by possible improvements to the existing system which should be revealed by the study. Deducting from existing costs the possible improvements is most important, and failure to do this may result in justifying an ADP system on economies which could be obtained within the framework of the present system. The most important elements in the present costs are labour costs, and the depreciation and maintenance of present equipment. Labour costs should be specified in sufficient detail to identify the cost of individual clerical operations.

Equipment costs should be taken on replacement values rather than on current costs which may be deflated because certain of the equipment in use has been written off.

The value of economies in space is not usually significant but in certain cases it can be very important. Where an anticipated expansion of staff which will necessitate new or enlarged premises can be avoided by using a computer, the

cost of providing the additional accommodation should be taken into the cost comparison.

DESIGNING THE DATA PROCESSING SYSTEM

By this stage the staff engaged on the study will need to have been trained in computer systems. Knowledge of punched card systems is a useful background for those studying computers but it is not a substitute for computer knowledge. Most computers can be programmed to simulate punched card systems but the use of a computer on punched card routines is very expensive. If the application is best suited to punched cards, then punched cards should be used rather than a computer. The computer systems approach differs from the punched card approach and this is why computer experience is needed in addition to general data processing experience. System design does not readily lend itself to the application of particular techniques, and it depends largely upon the skill of the staff employed whether or not a good data processing system is evolved.

One approach to the system design is to group the information to be output into period cycles, *eg.* daily, weekly and monthly, and then to plan routines for each of the cycles in turn, commencing with the daily cycle. The input and files required for computing and for compiling the information to be output can be determined and routines designed. Care is required when classifying period cycles. The cycles, in which routines are at present performed, may have resulted from limitations in the existing equipment or system. Even though information produced may only be used at the end of the period, the existing operations may have to be cycled daily because the volume of data is too great for a single operation at the period end. It is necessary with time cycles as with all aspects of the existing system to distinguish between the needs and limitations of the business or organisation, and those imposed by the present equipment or system.

In spite of what has been said about the need for computer systems experience, it is not necessary at this stage to attempt to produce an ideal computer system. The experience is needed in taking decisions whether or not to perform a particular part of the system on the computer. The proposed computer operations should be recorded simply and should do no more than to relate input, and filed data to produce the various output data. The facility with which the system can be operated will vary with different computers and the manufacturers' systems and programming staffs should decide how their own equipment can best meet the requirements.

Careful attention should be given at this stage to the flow of data to and from the computer. If the system is well designed it is unlikely that this part of it will change very much, whichever computer is eventually ordered. More detailed consideration can therefore be given to the data flow with the knowledge that the effort expended is not likely to be wasted.

In designing the system of data flow to the computer the aim should be that the data arrive at the computer complete in detail. Any scrutiny necessary should have been made previously and codes and characters checked for accuracy. Transcription into a form acceptable to the computer, *eg.* punched cards or punched paper tape, would then require a further check. Provision must be made in any system where information is stored within the computer for amendments and additions to be made to the filed information. The most satisfactory time for amendment will be during an operating cycle when the file is being referred to by the computer. Amending data will usually arise from a different source from the normal input. For example, in a production scheduling operation the main input could come from the production budget schedules or customers' orders but amendments to the product specifications would come from design modifications. The flow of amendments would have to be planned up to the stage where it joins the main input flow.

The need to refer to information held in the computer files when the computer is not actually operating on the file needs to be examined closely. An analysis of the reasons for reference to the files will usually show that a fair proportion of them arise because of limitations of the existing system and when these are eliminated, the reference needs can be satisfied without serious interruption to the computer operating schedule.

In some operations, reference to records is continuous and storage of the information in a computer is impracticable unless it has extensive facilities for random access to files. The need for random access to information can in certain circumstances preclude a routine from being transferred to a computer.

EXCEPTIONS

Exceptions to the main flow of work must be examined for incidence of occurrence. It is a feature of computers that they can deal with exceptions but attempts made to include all possible exceptions have resulted in routines requiring excessive computer times and being as a result, uneconomic. Exceptions which occur infrequently or which cause undue programming difficulty should be dealt with away from the computer.

Up to this stage the system will have been

designed by the study team in isolation. It will have been based on information obtained at varying organisational levels and on the personal knowledge of members of the study team, no attempt having been made to obtain the agreement of those whose activities the projected computer operations will affect.

This approach is intended to give the study team the opportunity to design the system with a minimum of influence exerted by existing limitations. Once the system is designed, however, it must be fully explained to the management and senior executives of the organisation and their acceptance obtained.

This is a very important part of the study which should be carefully planned. Personnel, to whom the system is to be explained, should first be given a general appreciation of what computers are, what they can do and their advantages and limitations. The system which has been designed can be introduced as part of a normal meeting or series of meetings or in the form of a lecture followed by discussions. The purpose of presenting the system in this way is twofold. Firstly, to test the system against the practical experience of those carrying out the functions at present and, secondly, to gain the confidence of the staff in the proposed system. Suggestions for modification and improvement should be welcomed and not regarded as criticism of the study team—no one person or group of persons can have a monopoly of ideas. Furthermore, the incorporation of the amendments will create the impression of the system being a collective effort and acceptance is likely to be obtained more easily.

SYSTEM SPECIFICATION FOR MANUFACTURERS

The object of the system specification for manufacturers is to obtain proposals which can be compared one with another. A system specification should set out the operations, time cycles and periods for producing information. The content of input and files showing the number and form of characters for each item should be tabulated and the content of information to be produced, supported where practicable by suggested forms of presentation.

Sufficient data should be included in the specification to enable manufacturers to recommend the equipment which would be needed to do the work, and no attempt should be made to anticipate the way in which they will recommend that their equipment should be used.

After studying the specification the manufacturers will probably ask for one or more meetings to obtain clarification of various points and time should be allowed for this in planning the work of the study team.

Proposals submitted by the manufacturers must be examined to see that provision has been made for all the requirements of the specification. It must be established that the equipment recommended can adequately deal with the volume of data to be processed and produced, when operated on a normal production basis. *(How to evaluate manufacturers' proposals will be the subject of a later article in this series.)*

A PLAN FOR CONVERSION

The preparation of a plan for conversion to the ADP system at this stage is required for three reasons:—

1. To show the likely effect of the computer on organisational structure and personnel.
2. To give an indication of the time conversion will take.
3. To ascertain the final element in the cost comparison, *ie.* the initial cost of system design, programming and parallel operations.

It should show the order in which the routines are to be transferred to the computer and proposed dates for the transfer.

'MOST SUITABLE COMPUTER'

The case for the most suitable computer is normally based on two sets of factors.

First, the economic factor is determined by relating the estimated cost of an ADP system based on the most suitable computer to the displaced costs of the present system which are the cost of meeting the requirements of the proposed ADP system by the most efficient use of existing equipment and staff. The cost of extending the existing equipment and staff to meet the anticipated growth of the organisation should also be estimated and included with existing costs on the assumption that the ADP system provides adequate capacity for expansion. Benefits claimed for the ADP system should be given a value wherever possible. Approximate values can and should be placed on benefits such as reduced inventories, better plant utilisation, greater sales penetration and better direction of marketing and selling.

Secondly, other factors might arise, which cannot be evaluated (*eg.* reduced complexity of management, morale of personnel). The importance of these could be difficult to assess in a case where economic benefits are marginal. It is desirable that benefits which can be evaluated should be sufficient to justify the introduction of the ADP system while other less tangible benefits will further improve this case. Generally speaking, if a satisfactory case cannot be made on factors which can be evaluated, a conversion to an ADP system is not warranted.

Integration for a Marketing Organisation

In a highly competitive market Philips Electrical has found a way to substantial administrative savings with a data handling system integrated from point of sale to planning top and control levels.

Keith Bean

A SELLING organisation selling at competitive prices must observe certain basic principles if it is to stay in business.

It must sell service. It must have the right product at the right place at the right time. It must have a sensible distribution of stocks. Supremely, since prices are keen, it must have economical administration.

These considerations have led Philips Electrical Ltd to an interesting extension of its mechanised data handling which it is now implementing, region by region, throughout the country.

'We don't apply mechanisation for purely doctrinaire reasons, but in the system we have evolved we saw a way of taking advantage of new developments, making worthwhile savings at a comparatively small capital outlay,' said Mr E N Evans, manager of the company's organisation and methods department.

Philips Electrical is the selling company for several factories making almost everything electrical. It markets such mass-produced lines as lamps and lighting equipment, radios and TV sets, radiograms and record-playing equipment, tape-recorders, dictating machines, razors, blankets, health lamps and other appliances as well as more specialised products like X-ray and other professional equipment.

THE FIELD

Its new system is being applied in its lamps and lighting group and its electrical appliances group.

It controls the activities of more than 150 salesmen, plus specialists, organised through six regions, each region having one or more branches and usually a depôt, which is also a small branch.

They market eight thousand different lamps and fittings. That is partly due to the lack of standardisation in this trade, giving rise to vast variations in wattages, voltages, bases (or caps), finish, colour and type of lamp (for cars, photography and general lighting, for example).

Indeed, the description and variety of the articles create one of the big troubles in mechanising the work. With such variations, a minimum description of an article can run to 30 or 40 letters and/or digits.

The company's quest was for an integrated data processing system which it defined thus: 'Simultaneously, with the creation of an initial document, sufficient information should be obtained in such a form that without manual transcription it can be processed to produce the necessary paper work and information for management.'

Obviously, for maximum benefit, integrated data processing must start at the earliest possible stage —in this case, receipt of the customer's order.

Under the manual system this meant the creation of advice notes for the customer, at the depôt and

branch and regional offices, followed by an invoice produced at the regional office. Then copies of invoices went to London for sales analysis by class of product, representative and so on. Stock returns went to London for financial stock valuation and to the commercial departments for distribution and sales planning.

'We found,' said Mr. Evans, 'that apart from the colossal amount of work involved in manual analysis we had also problems in the control of documents, since there was a tremendous amount of manual transcription. We found there were 15 different stages of controlling documents—all quite necessary under the manual system.

'So we decided to adopt the principle of integrated data processing whereby, as far as possible, all information regarding each transaction was obtained from one original document.

THE SOLUTION : INTEGRATED DATA PROCESSING

'To do this we introduced Flexowriter Programmatic machines into our branch and regional offices and we use them to produce the advice notes that cover each dispatch of goods to customers.

'Simultaneously, we produce an eight-channel punched tape which contains the information on the advice notes to give us, when converted into punched cards, (i) the invoice to customer, (ii) sales statistics of all kinds, (iii) financial stock records and (iv) stock obsolescence control. Stores, branches and regional offices also type on the Flexowriter all other documents recording stock movements, such as stock transfers, returns and so on.

'We also, using Flexowriters, summarise daily all stock movements and from the tape we supply, through punched-card tabulations three times a month, a summary for use by our planning and distribution departments.

'This return is based on the stock record within the stock point and a copy of the typewritten return is used daily to check physical stocks in the store. We thus have only one record of stocks within the stock point, and the bin record is eliminated.'

Accuracy under this system is achieved without the complicated controls needed in the manual system—checking of one document against another, controlling of documents by number and value, calculation and checking of invoice extensions and so on. All these are cut out and replaced by two major checks: (i) the checking of the original rough order with the advice note at branch and (ii) comparison of the ultimate invoice with the copy advice note in the central mechanisation department at Croydon.

THE MACHINE

The Flexowriter, then, is an electric typewriter linked with a tape punch and it also has a reading head which can read information from a tape or perforated card. It can be used as a normal electric typewriter but, further, it can be programmed to type automatically information which is either read or keyed into it.

The carriage of the machine is controlled entirely by the programme, and the machine, acting under coded instructions, positions the documents and types information into them at high speed. The information typed on the document is also automatically reproduced in the paper tape, either completely or in part since the punching into the tape can be selectively controlled.

The machine's ability to read information is particularly useful.

It permits the recording of non-variable information in a master card which can be used to activate the Flexowriter. Thus a file of name and address cards can be made and used for preparing advice notes and a similar arrangement can be made for all articles sold by branches and depots. The pre-punched cards, once checked, eliminate the possibility of error.

The paper tape is the link between the Flexowriter and other equipment. Its language is

'. . . we decided to adopt the principle of integrated data processing whereby, as far as possible, all information regarding each transaction was obtained from one original document.'

common, which means that it can be understood by all the organisation's punched-card equipment. (Besides the selling company, the factories have their own installations, all standardised on IBM equipment—using the 604 electronic calculator and the 421 accounting machine.) An IBM 047 converter converts the tape to punched cards which can then be used for invoicing, sales analysis, stock recording and so on.

An important feature here is that such a conversion eliminates the most expensive and probably the least reliable aspects of punched card procedure—pulling, punching and verifying.

THE SAVINGS

The company estimates that the new system will save a substantial part of the administrative costs and should also bring economies in other departments.

'The decision taken, the implementing of these plans for integrated data processing, is still of course a tremendous task,' said Mr Evans.

'Besides demonstrating the advantages generally to all staff, the training of Flexowriter operators and the preparation of card files and other stationery requires careful planning and a long period of hard work.

'We used one Flexowriter in a six-month pilot scheme at a typical branch and by operating it alongside the normal manual system proved that the claimed advantages could in fact be realised.'

The next step was the introduction of Flexowriters to other branches in a similar way. Manual invoicing is continued in the regional office until after two months working experience on the Flexowriter. Invoicing is done centrally at Croydon from the punched cards obtained.

The change to the new system is being done region by region, beginning with the Midlands region which went over on September 1 last year. The company expects that all its regions will have switched over by the end of September 1960.

Concurrently with the preparatory work in the branches, the central mechanisation department (established in 1953) was installing the new punched card equipment needed to carry out the tasks of a central processing unit under the new system. Other preliminary work included the standardisation of descriptions—found to be necessary even between different departments within the organisation—coding of all products and the formation of a team to ensure co-ordination of all interested departments in the development of the project.

'We had to establish a discipline for operation of the whole of the system which would give us a standard procedure at all our branches and stock points which it was impossible to achieve previously under manual methods.

'Now integrated data processing will give us improved administration for a smaller cost. We expect:

1. Over-all increase in efficiency (a better financial control of stocks throughout the organisation' improved efficiency in invoicing, etc) and ability to deal with our expanding turnover.
2. A better service of statistical information which should be a big help to management, and
3. Streamlining in the organisation generally which should result in the direct savings we have shown but also in other savings we were not able to budget in our initial cost appreciation.'

The company also sees the new system as in line with other developments taking shape—for example, the rationalising of its distribution and planning system to relate it more directly to actual sales. Improved electronic equipment in the central mechanisation department will help here with statistics.

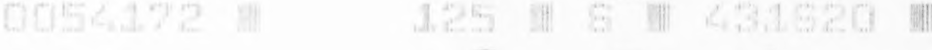
'We have in mind the possibility of using commercial computers and are already using equipment which borders on the computer field,' said Mr Evans.

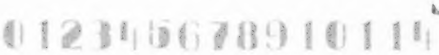
'It is essential, however, that the organisation itself be streamlined and integrated even before we study the enormous problems and possibilities of a computer.

'This is the aim of our new methods. We are working a sound integrated system which is simple to operate at the selling points and which will enable us at a later stage to take full advantage of modern electronic devices.'

The May issue of AUTOMATIC DATA PROCESSING will contain a preview of the Business Efficiency Exhibition to be held in Birmingham from May 16-21, highlighting equipment which can be used by companies large and small to produce the following effects: economic *mechanisation* of office work, better *communication* of information and better *control*.

Character Recognition for Banks





Basic to any system of electronic accounting for banks will be machines which can read and sort documents, if present money transfer arrangements are to be maintained. So far three methods have been evolved for reading and sorting bank documents. *[Above in colour: E 13 B (top), Bull (centre) and Fred (bottom) typefaces]*

R Hindle

THE banker's problem in organising his system is to deal with vast quantities of slips of paper. The 'slip' method is very convenient for manual accounting systems. Once the vouchers are made out, records in this form are convenient to handle and can be sorted readily into any required order, so that entries can be made in the most efficient manner. Work can be divided between staff; and indeed the whole process is flexible.

For the banks, of course, the problem of producing vouchers is practically non-existent because by far the greater part of them are actually written by the customers who present them to the bank for attention. Cheques form a high proportion of such vouchers, and the credit slips also written by customers almost complete the task. The credits referred to include such items as entries passing through the Traders' Credit system, dividends sent to banks to be credited to their accounts and so on, as well as the paying-in slips written by bank customers and their agents. The voucher system is, thus, not merely a convenient system so far as the banking accountant is concerned but is in fact a fundamental feature of the business of banking. No bank could really contemplate any alternative method of originating entries or would dare to suggest to customers at the present stage that they should end their practice of writing cheques and instructing the bank to transfer funds in the form of a credit advice.

In the present situation the problem is to discover how to handle the vouchers as now used in a system requiring lesser human intervention. Cheques and credit slips are produced in all manner of ways; they may be handwritten or they may be printed in a wide variety of type faces on all kinds of keyboard or printing machinery. The variety of character form are infinite.

MECHANICAL HANDLING

The need clearly is for means for automatically handling vouchers, and for reading their data, in order to avoid a great deal of manual work. The need to sort vouchers accounts for a considerable proportion of staff time, while the remainder of the time is taken up in repeatedly reading the significant data from vouchers (amounts, descriptions and the identity of the accounts involved).

The mechanics of automatic voucher handling have been worked out already. Three different versions for cheque sorting have been developed for banking use in the USA and one in France, whilst others are expected to come forward in this country. These have not come easily. Though

punched cards have been handled with great precision and speed in automatic devices for a long time the same techniques were not suitable for handling paper vouchers. The material used for punched cards is of closely controlled quality and stiffness, and the cards themselves are made to a standard size within a very close tolerance. The vouchers handled by banks vary widely in paper quality and in size. The range of qualities will have to be reduced. At the present time it seems that the sorters will handle the current standard British cheque paper but there is just a chance that it might have to be stiffened somewhat. It would be very difficult to standardise on a single cheque size. Manufacturers were asked therefore to produce machines capable of handling intermixed sizes between the limits of eight inches by four and six inches by three (the range of size agreed between banks for cheques to be handled in manual systems) and the machines referred to above will do this quite happily. Credit and other vouchers will have to come into line with the cheque both as regards quality of paper and size and many banks are now in process of bringing this about.

Of course, for a machine to deal with vouchers automatically it must be able to detect their nature. If it is to sort, the machine must be able to read the key on which it is to sort; if it is to list it must be able to read the amount on the voucher, and if it is to post accounts it must be able to read the account identity, description of the item and amount.

AUTOMATIC READING

Ideally, the machine should be endowed with the ability to read all the varieties of handwriting and print that exist on cheques. This has been a scientific dream for some time and appreciable steps have been taken in this direction within the confines of laboratories. In due course the problem may be solved completely. However, the banks have been realistic in this matter. It seemed to them that such perfection in character recognition offering the kind of reliability that they must insist on having, in view of the nature of their business, would take a long time to develop and was almost bound to be prohibitively expensive if and when it came. How could they proceed meanwhile?

NUMERIC CODE

The first step was to restrict to numerals only the characters that they wished to be read automatically, with the addition of a few extra symbols which need not correspond with any characters familiar to the human eye and which would be used to give instructions to the machine through the reading device.

Is it practicable, then, to use numerals only? The following data have to be provided:

1—The amount. Clearly this is numeric and can be represented by the proposed characters.

2—The branch of the bank to which the entry is destined. This is necessary because the majority of entries originate away from the office holding the operated account and have to pass through the clearing channels. A numeric code is already in use for this purpose and though this may not be suitable for the future it is reasonable to assume that an alternative purely numeric identity can be provided.

3—The account to which the item has to be passed. Almost invariably in the past an account has been identified by the name of the customer. Even on manual systems this has caused embarrassment due to accounts with similar names. The banks are resigned to the need to number their accounts (though, of course, customers will be known still by name, the number being for internal purposes only) and some are already proceeding on these lines.

4—The description of the transaction. This is largely bound up with the question of the amount of description that is given on statements and in ledgers alongside every entry. This is a highly controversial matter but banks generally are coming round to the view that such cumbersome 'narrative' has to be dropped. Cheque numbers will be given and also a limited range of standard abbreviations which can be represented, so far as the reading and computing equipment is concerned, by a numeric code.

It seems, therefore, that there will be no difficulty in working with a purely numeric code.

AVAILABLE SYSTEMS

The Bank of America, operating in California, has led the way in the matter of this limited form of character recognition suitable for bank use. The bank commissioned the Stanford Research Institute to develop an automatic banking system and out of this came the basic recognition system.

Research on behalf of the American Bankers' Association followed up the Bank of America's basic research and all the major accounting machine manufacturers in the USA combined to add refinements so that the resultant system could be truly universal in its application, capable of being read by machines produced by any of them. The eventual outcome was the type-font known as E13B and this was finally accepted by the American Bankers' Association as the official form of code for use by American banks. It is desirable, of course, that banks should agree to

use a standard code because their work is so completely interdependent. The E13B character form appears somewhat strange but nevertheless the characters are quite easily read by eye.

In this country, starting work much later than the Americans, EMI have worked on a method of limited character recognition with scope similar to that of E13B. Discouraged a little by slow progress in the USA after such a promising start, many banks in this country have shown considerable interest in this native development which has been given the code name FRED (figure reading electronic device) and they await the opportunity of comparing with the now successful E13B the outcome of the work being done in the EMI laboratory. The character form is a little more pleasing to the eye than E13B; and the makers claim some advantage in their reading technique.

A third version more recently presented by the Compagnie des Machines Bull, through their English associate De La Rue Bull Machines, is also under consideration.

There are other reading systems, of course, for instance those of Solartron and Intelligent Machines Research. These were intended to provide more versatile facilities and consequently have been considered less suitable for banking purposes because of their complexity.

METHOD OF RECOGNITION

The three systems of recognition, E13B, FRED and Bull, in their banking applications, are to be based on magnetic rather than optical principles. The logic of recognition is unchanged by this choice, the two techniques being simply alternative methods of detecting the presence of ink. For magnetic detection the ink used in printing the character holds in suspension fine particles of a magnetic material. The reason for preferring magnetic detection is that the vouchers handled by banks are liable to contamination by means of rubber stamps, ink marks and the like and if these fall into the area occupied by the characters an optical system is liable to be upset.

The systems of recognition referred to have similarities in their methods. None are true shape recognition systems; in fact, all see in the characters a simple binary code which consequently does not require elaborate recognition circuits. For their purpose banks are reconciled to the use of numerals only, plus a few characters which need have no particular significance to the human eye but which will be used to define the limits of the various blocks of information and will also serve to assist the logical circuits in identifying particular blocks. The most obvious way to identify a particular block is, perhaps, by counting digits from a datum point, *eg.* from the leading edge of the cheque, but this is not necessarily a very tidy solution to the banking problem owing to the possibilities of misprints, or prints outside tolerances, or even the possible complete omission of a block. The amount, for instance, might not always appear in code at the time of voucher sorting. Tolerance difficulties preclude the selection of a block merely by means of timing from the datum point, though in fact such a timing method is used in some cases to define very roughly the position of the block to be read but then one of the special symbols is sought for exact location of the block. These symbols are referred to as ' inter-block ' symbols.

The agreement to limit the range of characters to numerals, plus a few inter-block symbols, greatly simplifies the method of recognition. The E13B character is suited to the different techniques of the various manufacturers participating. One method breaks up the character into a coarse pattern as though a grid of squares were superposed, each square being sampled to see if it is predominantly ink-covered or inkless. The resulting binary pattern, or at least the significant parts of it that represent the essential differences between characters, provides the clues as to the character represented. This is a flexible system that can be adjusted to accept different type-fonts. An alternative method which is more completely allied to the particular character form examines the character through a narrow slot, sampling the height of the character at one time, detecting each change in the state of inking across the width of the character and intercepting it as an electrical pulse. These unidirectional (binary) pulses differ in their time relationship from character to character and the pattern produced by the reading head can be correlated with the standard patterns remembered by the logical circuits, the one with which it most closely agrees indicating the character being read. The E13B system provides four inter-block characters in addition to the ten numerals.

The FRED system samples each character five times, reading it as though it were divided into five vertical stripes. If the sample is predominantly ' black ' (*ie.*, if ink exists over the major part of the height of the sample) it indicates a binary ' 1 ' but if it is predominantly ' white ' (indicated by the absence of ink) it indicates a binary ' 0.' It is well known in other contexts that a single decimal digit can be represented by the permutations of four binary digits; the fifth sample is added in the case of FRED to act as a ' start read ' signal. Four bits provide $2^4 - 1$, or 15 possible characters, thus allowing for the inter-block symbols. Two of these additional symbols can be made to resemble ' 10 ' and ' 11 ' (' $\frac{1}{2}$ ' can be represented also, but

banks do not contemplate any use for it) with obvious value in the representation of sterling amounts. Also the codes can be formed to have visual resemblance to alphabetical instead of numeric characters though the reader itself cannot distinguish between a numeral and its corresponding alphabetical character.

Development of the basic FRED scheme using optical methods of reading took place when magnetics were introduced. Instead of sampling the character through a single slot each vertical stripe is now examined by a number of heads in the vertical dimensions, each one of the heads in the stack examining a section of the vertical column only. In order to interpret a vertical section as a 'black,' two adjacent reading heads must see a 'black' in their own sections. Thus a visually fine line such as is used to make the character legible, if magnetically intense, will not give the impression of being a black column. A further development is likely to add greater theoretical redundancy which under certain circumstances may give a higher degree of reading accuracy.

The Bull method shares the principle of incorporating a binary code within the character but in a somewhat different way. The character is visually broken up into stripes with six inkless gaps between and as the whole character is printed within an eighth of an inch space the gaps are not immediately obvious at normal reading distances. This system does not sample the character as before. Instead it detects the absence of ink. Two different widths of gaps are used in the character and the reader measures the time interval between the ink stripes. Four narrow and two wide gaps are present in each character and the code is thus a 'two out of six' scheme. The system thus has in a high degree a self-checking proof of correct reading. This system also provides 15 characters by this method, though presumably by dropping the 'two out of six' self-checking feature the system could be developed to provide 63 [$2^6 - 1$] different characters.

TYPES OF ERROR

Two kinds of error can occur in character reading—one is to misread, *ie.* to interpret the character wrongly. This is most serious. The other kind is to fail completely, *ie.* to reject. This is not quite such a worry to banks. The ability to reject rather than misread depends largely on the degree of redundant intelligence carried on in the code, and unfortunately the systems considered are made simple and therefore cheap by eliminating redundant data. The banks in assessing the character forms offered will have to pay a lot of attention to this aspect and only by careful statistical analysis of a large number of readings are they likely to be able to satisfy themselves. It is interesting to compare, however, the steps taken in the three reading systems on this account. In the case of Bull, the use of the 'two out of six' check is a safeguard, the use of only two significant digits in a six-bit code providing quite a useful reserve of information. The E13B system provides some protection by defining the proportions of ink area in each sample which is acceptable as a '1' or a '0.' FRED breaks up each sample vertically by the use of a multiple reading head. This system requires that two vertically adjacent blacks be detected before it will accept the sample as a '1.'

The E13B method is the only one to be seen actually in operation in a banking system and this must weigh heavily in the minds of those attempting to assess the methods. It remains to be seen now if the other two methods can be proved to have advantages over E13B sufficient to outweigh the admitted advantage of being first to be put to practical use.

A Pilot System at Martins Bank

MR R HINDLE, the author of the preceding article, is Manager of Organisation Research and Development at the head office of Martins Bank Limited. Early in February, at the Ferranti Centre in Portland Place, he described how a Ferranti Pegasus computer was being used to process all the current accounts at a branch of Martins Bank in the West End of London.

The Pegasus is being used for the posting of all normal debit and credit entries, including corrections, for the alteration of account information, the addition of new accounts, the removal of closed accounts and for the accumulation of statistics for management information, interest charges, etc.

A check of each debit entry is made against a list of stops. Any stop found is rejected by the computer. The closing balance of each account or group of 'set-off' accounts is compared with overdraft limits. Any excess of these limits causes control information to be printed out for

managerial attention. Customers' statements are printed periodically on a basis agreed with the customer, with provision for additional statements by special request.

Lists of debit and credit balances, with details of any rejected items, are accumulated and printed out daily for return to the branch.

THE METHOD

Two main files, the balance file and the history file, form the basis of the system. Both are stored on magnetic tape in account number order and contain the following information in respect of each account: (1) the balance file contains the account number, name, balance, report limit, overdraft limit, details of stopped cheques, and accumulated statistics for management information and the calculation of charges; (2) the history file contains the account number, name, frequency with which the statement is to be issued, the balance and date from the previous statement, and the date, description and amount of each posting awaiting print-out on the next statement.

Both these files need to be updated each day in respect of the vouchers passing through the branch, and it is therefore necessary to transcribe the relevant details from the vouchers on to paper tape.

DAILY ROUTINE

All vouchers entering the branch pass daily through one of two listing operations: either the 'inclearing' or the 'waste.' By adding a paper tape punch to a conventional accounting machine (Addo-X prototype is being used) the paper tape input is prepared as a by-product of the normal waste function. Details (account number, simple description and amount) from each voucher are keyed into the machine and printed on either the inclearing list or the waste sheet and simultaneously punched into tape. Checked totals are punched at intervals and used by the operator to check the entries on the machine and by the computer to check data on input. (It may be noted that no vouchers leave the branch office.)

The prepared data are taken (by hand at present) to the computer centre where they are processed. They are read into the computer through a high-speed tape reader and stored on magnetic tape. During this operation the format of each entry is checked, each account number is checked against a check digit, and the amount of each entry is accumulated to produce balancing totals. Any discrepancies revealed by these checks cause the appropriate entries to be rejected and printed out for investigation.

The entries stored on magnetic tape are sorted by the computer into account number order. The sorted entries are then processed against the balance file. The account number, name and new balance for each account is punched out for the balance list. Other statistical data are adjusted and each closing balance is checked against the limits. When a balance exceeds the agreed limit, the limit is printed in the extreme right-hand column of the balance list, showing at a glance accounts that require managerial attention. All debit entries are checked against the stop list and stops rejected. New accounts are added to the file in correct sequence and accounts which are closed are removed.

R. Hindle, Martins' manager of Organisation Research and Development, watches how it comes out of the page-receiver

Following the balance file, the history file is run through the computer. Each entry accounted for in the balance file is written into the history file. The statement frequency of each account is inspected and, if due, details are punched out.

PREPARATION AT THE BRANCH

Data is prepared at the branch as vouchers arrive, and completed data tapes are ready for processing by about 3.30 p.m. (half an hour after the bank closes to customers). In the pilot scheme the total time required for computer processing is 17 minutes, including setting up. It is expected that when the processing is transferred from Pegasus I to Pegasus II, this time will be reduced by about one-third.

ACCURACY

The whole operation is very thoroughly checked, both during the preparation of data at the branch and, automatically, during computer processing. 'There is no doubt,' Mr Hindle says, 'that this book-keeping system has a far higher degree of safeguard against errors than any system that can be visualised, using conventional equipment.'

'IMAGINATIVE USES' for Computers

Usually acquired for bread-and-butter jobs like payroll and costing, computers—particularly the ones that are presently being built—have powerful (and unexploited) logical abilities to do work on sophisticated 'management science' problems. So the door is open to new imaginative and profitable computer applications.

IT is always interesting to discuss 'the next generation of computers,' and to speculate on fantastic new speeds and ever-dwindling miniaturisation. The vestpocket computer at instantaneous speeds may indeed be round the corner, and although the price will probably be steep, the user will undoubtedly be 'getting more for his million dollars.' But in the meantime, perhaps it may be well for industry in general to take time off from the breathless race to keep up with hardware innovations, and to ask itself, 'Are we really using what we've got?'

It is worth noting that in gatherings of computer users and management personnel, the question has increasingly been raised of late as to whether industry by and large has learned to use effectively the logical abilities of existing data processing equipment. In any ADP installation, payroll, billing, general accounting, and similar applications are usually undertaken first, because of the familiarity with mechanisation of such operations. But one reason for disappointments thus far experienced is that where such operations have been mechanised, additional economies are not impressive. Clearly, what is called for here is systems planning that will provide management with entirely new types of information for decision making—information that it never had before.

As a company gains experience with its computer, non-routine applications must be given increasing attention, in order to get computer 'payout' by turning it to problems that heretofore could not be handled economically, if at all. New and imaginative uses must be discovered.

'Management-science' types of problems must be increasingly tackled, in the areas of optimum production scheduling . . . minimising of inventory investment . . . solution of transportation problems, where the objective is to minimise combinations of transport, warehousing, and manufacturing costs. More and more 'imagineering' must be applied.

The following paragraphs bring together representative case examples of imaginative uses of computers. They are typical of applications that can add effectively to returns, often with relatively small use of computer time.

One of the interesting phenomena attending the use of computers by chemical and petroleum companies is the wide variation in the level of activity with respect to computer usage from company to company. Among those who are taking full advantage of computer potentials is Monsanto Chemical Company.

At present Monsanto has in St. Louis an

IBM 704, and a 140-amplifier analogue which is shortly to be expanded to 228 amplifiers. In Texas City, Texas, and in Springfield, Mass., Monsanto has two IBM 650's. The IBM 702 is used entirely for the general accounting work of Monsanto for all divisions. Before the installation of the 704, scientific and engineering digital computation was also done on the 702.

The two IBM 650 computers are used primarily for accounting, with a small amount of scientific computation as the accounting load permits. The IBM 704 is used entirely for scientific and engineering applications, and for all studies that are not accounting in the narrow sense of the word. It is available for use by all segments of the company. This wide variety of computing capability provides Monsanto with as much and probably more computational facilities than any other of the leading chemical companies.

In addition to such non-accounting applications as determination of manufacturing schedules and economic and market study problems, the following are some of the interesting applications being performed at Monsanto.

OPERATIONAL RESEARCH AND OPERATIONS STUDIES

There are several applications in this area, the first of which—use of the 704 for petroleum blending calculations—need be mentioned only briefly because it is now quite commonly used by petroleum companies. The use of linear programming techniques to determine minimum cost blends of several refinery streams to obtain final blended petroleums has been described widely. Monsanto is also studying, at present, methods of simulating the operations of the refinery on the computer.

An application unique to Monsanto has been the development of a computer program to calculate granular fertiliser formulations, and to provide this as a customer service. Monsanto is a large producer of basic raw materials consumed by the fertiliser industry. By making available a method of determining minimum cost formulations of fertiliser materials that will meet all the necessary requirements, the company increased its sales greatly.

The computer solves a set of nonlinear, discontinuous algebraic equations which express heat, material, and moisture balances as well as considering certain operational features of the formulator's plant. The computer program determines, for a given fertiliser grade for a given customer, formulations which will minimise his raw-material costs and maximise the efficiency of his plant. To date, more than half a million

APPLICATION SCREENING REPORT

CP # 19999 PSEUDOTHIOHYDANTOIN

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02C11N
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SUBMITTER A. J. SPEZIALE DATE 03/57

		PERCENT KILL				PERCENT KILL	
A	AT	10PPM	2.5PPM	K	AT	.01%	
		00	00			00	
P	AT	.1%		Q	AT	.01%	
		00				00	

ORGANISM, HOST, OR OBJECT

A	B	C
D	E	F
G	H	I
J	K	L
M	N	O
P	Q	R

COMMENTS
NO FURTHER INTEREST

Print-out of screening report. The report contains the compound number and name according to Monsanto numbering system, coded structural chemical information, and other information as to the effectiveness of the compound for the particular application for which it was tested.

tormulations have been calculated on the computer.

INFORMATION RETRIEVAL AND REPORT WRITING

Screening reports for chemicals prepared or studied in Monsanto laboratories are prepared by scientists in certain applications research groups. These reports are one-page forms which give the name, structure, and serial number of the compound, the name of the chemist who prepared it, and his location, the raw data obtained in the screening operation and the evaluation of the compound as a result of the screening test. These one-page reports are now prepared in six copies by the computer from a carbon copy of the research man's laboratory notebook and from data about the compound from the chemist. (See figure on page 29.)

To date, thousands of screening reports have been printed, and many scientists have been relieved of the daily chore of filling in forms and transcribing data. A backlog of chemicals to be screened has been virtually eliminated, and the scientists are now able to spend their time in more creative, stimulating, and profitable pursuits.

The procedure is as follows: the carbon copy from the laboratory notebook is removed and the data punched in cards as a routine process. These data cards plus the computer program are fed into the computer. Stored on magnetic tape is an up-to-date list of chemical names, and a list of chemical structures. These structures have been coded in a very simple way for the computer. The computer operates for a few minutes and then produces six copies of the desired reports. These are put in the mail and thus the screening laboratory has fulfilled its reporting requirements to supervision, management, development, and others involved.

Methods have also been developed to search the files of chemical structures in such a fashion that any arbitrary search question can be answered. A chemist may wish to search for all compounds that contain two specific groups on a benzene ring such as nitro and amino groups, or he may wish to find all derivatives of a certain compound. Monsanto has developed, although it is not completely perfected as yet, a method of answering these questions on the computer.

Computers will be used for retrieval of various kinds of information. Magnetic-tape and magnetic-disc storages offer opportunities for storing large files of information—ie, development data, research data, market data, and so on. A computer program can then be used to search these data for certain specific items. There are some thorny theoretical problems of indexing and classification involved, but these are expected to be solved in time.

A UNIQUE METHOD OF FILING

A way of utilising the full economic advantage of electronic data processing to do the complete work of maintaining and processing stockholder records has been developed by the First National Bank of Boston. (The bank uses the large scale Minneapolis-Honeywell Datamatic 1000 system for its electronic data processing activities.) The breakthrough was made possible by an ingenious filekeeping method, 'Name Code Generation.'

THE PROBLEM

The basic problem was to maintain records in alphabetical order with respect to each issue of stock for which the Bank acts as transfer agent, and to post on an average some 6,000 transactions per day to the file of over 900,000 accounts. Classically, the only practical way that this has been done on any kind of automatic or semi-automatic equipment has been to assign to each account a number in such a manner as to preserve the alphabetic sequence.

This is quite different from most applications, where files may be maintained in numerical sequence, with little or no regard to alphabetical order, and where an account number may be recorded on most input media. Unlike the latter instances, in transfer work every transaction must be referred to the file and a number assigned to it—a task which is time-consuming and laborious. It is costly as well—some transfer agents have expressed the opinion that the added cost of this work is sufficient to offset any savings that might be realised from mechanical or electronic equipment.

First National Bank felt that the problem could be resolved by using the computer to generate its own key, or account number. This number would maintain the file in alphabetical order and also, being unique, would enable the machine to locate accounts and post to them, as well as insert new accounts in proper position.

A PRACTICAL SOLUTION

'Name Code' is a practical solution to the problem of maintaining large files in alphabetical order where the volume of daily transactions is relatively small—in the case of The First, 67/100 of 1 percent of the accounts on the file are affected daily. The calculation of the key is relatively slow, by computer standards, and could become a significant factor in an active file. Hence, the code is not designed to substitute for numerical filing systems where they can be used.

The latter are normally the most efficient in machine operations.

'Name Code' can be defined as a set of rules under which the computer automatically selects 16 alphabetic characters from the stockholder's name, or the legal title in which the stock is registered. These characters are thereafter used by the computer for sorting, filing, and posting operations in place of an ordinary account number. In general, the routine defines as a 'word' any character or group of characters in the title that are followed by a space.

To the computer, 'Charles R White' is three words. Certain words commonly found in titles are momentarily accepted, recognised, and then rejected in generating the code. These are 'in,' 'the,' 'of,' and the ampersand symbol (&). 'Miss' and 'Mrs,' when they appear at the beginning of a stockholder's name, are similarly rejected in generating the code.

KEYING THE BASIC WORD

Since, of course, the computer itself is unfamiliar with a filing system as such, it is necessary that the basic word in the title, under which the item is to be filed, be keyed so that the computer may recognise it. This is accomplished by having the typist, when she prepares a new stock certificate or a transfer record, place one or two colons in the proper location in the title. Only the high dot appears on the document, since the bottom dot has been removed from the type bars on the typewriters. This dot permits visual examination of the source data to determine that the colon has been properly positioned. As a by-product of the typing operation, punched paper tape is prepared, which is subsequently used as input to the computer system.

The typist must follow certain simple rules in preparing the original documents: She must place one colon in the space which would otherwise appear immediately before the word in the title under which the account is to be primarily filed. If a fiduciary is named, a second colon must precede the given (first) name of the first beneficiary mentioned; if no beneficiary is mentioned, then the second colon must precede the surname of the principal.

Under a carefully defined set of rules, the computer then proceeds to extract from the 'colonated' words, and from other words in the title, the key of 16 alphabetical characters. These characters are chosen as a strict function of the number of words in the title. (See figure.)

SAMPLES OF TWO-WORD ACCOUNT CODES GENERATED FROM TITLES WITH:

ONE WORD:	•ALCOATING 40 GREEN ST BOSTON MASS	ALCOATIN	————
TWO WORDS:	WILLIAM•ANDERSON 566 GENEVA AVE NEWTON MASS	ANDERSON	WILLIAM–
THREE WORDS:	MRS WALTER GEORGE•BERNARD 70 STOKES ST MORESTOWN N Y	BERNARD–	WALTERGE
FOUR WORDS:	WALTER GEORGE•BERNARD JR 70 STOKES ST MORESTOWN N Y	BERNARD–	WALTGEJR
FIVE WORDS:	JAMES•CALLISTER AND MARY CALLISTER JTRS 220 SOUTH ST BURLINGTON MASS	CALLISTE	JAMMCAJT
SIX WORDS:	MRS MICHAEL PETER•DEMPSEY AND JOHN DEMPSEY COOWNERS 120 COLBERT AVE BOSTON MASS	DEMPSEMI	CPJODECO
MORE THAN SIX WORDS:	MISS CLARA KATHRYN•EMERSON AND MISS MARY ELLEN EMERSON JT TEN ETC 132 RUE ST BOSTON MASS	EMERSOCL	AKMIMAEL
MORE THAN SIX WORDS WITH A SECOND COLON BEYOND THE SIXTH WORD: (FIDUCIARY ACCOUNTS)	PHILIP H•FRIEDMAN AND FREDERICK S BENSON JOINT TRUSTEES U/W/O THOMAS B HARRISON F/B/O•MARY HARRISON BOX 332 WHITMAN MASS	FRIEDMPH	IHFRMARY
	PHILIP H•FRIEDMAN AND FREDERICK S BENSON JOINT TRUSTEES U/W/O THOMAS B•HARRISON BOX 332 WHITMAN MASS	FRIEDMPH	IHFRHARR

REDUNDANCY — 600 PEOPLE NAMED 'JONES'!

In any reasonably large file there is a great deal of similarity in names or titles. In fact, precisely the same name may appear frequently. The First of Boston has 600 Joneses listed as owners of one stock issue alone! Since the code is based upon the name alone, duplicate keys also appear. In experiments with its own stockholders' list of approximately 23,400 accounts, the bank found that it had a total of 686 redundant keys. To put it another way, 97 per cent of the keys were unique, 3 percent were redundant. The program therefore had to take cognisance of the fact that redundant keys could and would exist.

Approximately one-half of the day's transactions are debits—certificates of stock being surrendered for cancellation as a result of a sale or some similar activity on the part of the stockholder. In each case a certificate number is known and must be recorded. Hence, the computer is instructed, when it finds an account with a key the same as that on the transaction, to look for the number of the certificate being surrendered. If it finds it, and the number of shares agree, and it has not been previously recorded as surrendered, it posts the surrender date and adjusts the ledger balances accordingly. This reduces the redundancy factor to $1\frac{1}{2}$ percent—those where credits, or certificates issued, are involved. In this instance, the computer is instructed to check the

file to see if one or more accounts have the same key as that developed from the title on the new certificate. If such redundancy does exist, it examines each word in the title of the certificate and compares it with that on the file. If a similarity exists, it checks the street address of the stockholder, word for word.

If these comparisons are satisfied, the certificate is added to the account. If the comparison is not satisfied, a new account is opened and the certificate is posted to it.

The only mistake the computer can make under the program is to open a second account for a stockholder when he should have but one such account. This might be the result of some minor variation in the way an address is stated, which would be obvious to a human being. To guard against this possibility, whenever the computer opens a new account on the file, and there are one or more accounts already on the file with identical keys, it reports the new account so opened, and gives the details with respect to the other account or accounts, with the same key. This report is then scanned to determine whether or not the new account should be consolidated with one that is already on the file. The bank's experience to date indicates that there are only three or four such items to be examined each day.

The First operated this routine on its computer for a number of months and, after exhaustive tests with about 10 percent of its files, decided to proceed with the work of converting the remaining 810,000 accounts to this system.

INTER-COMPANY DATA PROCESSING

There is growing interest in intercompany data processing. This calls for imagineering of the first order, for it envisages tremendous economies in business transactions between a company and its customers and suppliers. Companies with internal integrated processing systems must now convert their data into conventional language documents before sending them to another company. In turn, the company receiving the data must reconvert them so that they will feed into its own ADP systems. 'Conversion centres' at the input and output ends of ADP involve large clerical forces. They could be eliminated by the use of intercompany data processing.

It is conceivable that punched cards could be used for orders and catalogue information, for vendors' packing slips, and the like—all utilised in the data processing systems of all companies concerned.

THE 'COMING REVOLUTION'

The opportunities here have increasingly been engaging the interests of computer people, and some have, indeed, characterised the movement as 'the coming revolution in information handling.' Developments in magnetic ink character recognition, and the demonstration that so far-flung and heterogeneous an industry as banking can agree on standardised document format and types, have, perhaps, brought us nearer to the 'revolution' than many realise.

Rudolph Borchardt, General Supervisor of Data Processing for Western Union Telegraph Company's Market Research Department, has pointed out that a great deal of systems and forms standardisation in industry will have to precede any large-scale application of automatic encoding and conversion. Sequence of information and positioning of data would have to be standardised largely on purchase and sales order forms. As banks have found out with cheques, while it is one thing to standardise on your own company's forms over which you have complete control, it is quite another story to try to standardise other companies' forms that are sent in.

The sort of universal effort would be required that many years ago resulted in the Universal Bill of Lading. But the potential savings from an industry-wide program are worth considerable effort.

Mr. Borchardt visualises business forms printed in human language and simultaneously coded in machine language as only an intermediate stage before eliminating business forms in human language altogether. (However, magnetic ink recognition may make this hard-to-reach objective not necessary literally.) It is not considered far-fetched to think of computers, located on the premises of different companies, conversing with each other 'on-line.' This could involve transmitting order information from company A to company B, and then, by reversing the communications flow, transmitting a series of invoices for accomplished shipments from company A to company B.

To further intercompany data processing, trade associations and professional groups will have to concentrate on such items as:

1. Standardisation of material specifications within each industry.
2. Standard terminology.
3. Uniform positioning of data on business forms.
4. Standardisation on one universal machine language for business data interchange.

AIRLINE PURCHASING

Along with the developments in banking, airline purchasing is perhaps one of the most effective

continued on page 44

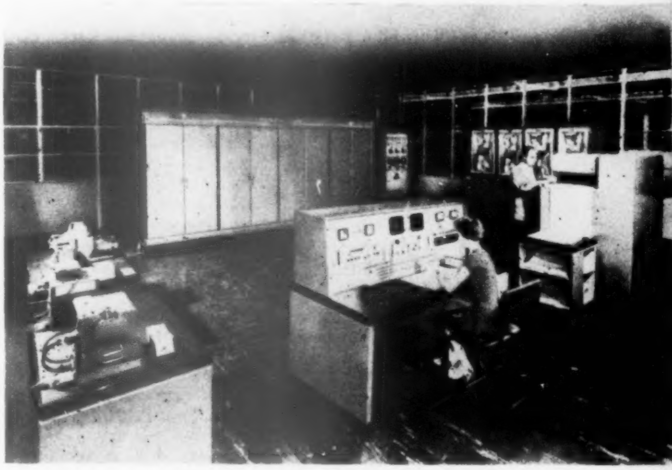
Features of the Emidec *1100* Computer

ONE of the first computers with magnetic core and transistor construction throughout, Emidec 1100 was primarily developed for data processing in commerce and industry.

Designed and constructed by EMI Electronics Ltd, Emidec 1100 embodies experience gained as a result of many years in the electronics field. Although EMI has long occupied a leading position in the electronics industry, major commitments, especially on defence projects, prevented entry specifically into the computer field until the last five years. However, this situation had the advantage than when an entry was made, the development of computer applications over the previous ten years could be reviewed in the light of the best electronic techniques becoming available to produce a computer system which may be considered as the first of the new generation.

In fact during the years 1955 and 1956 activity was concentrated on consideration not only of the most suitable characteristics for a computer to be deployed on commercial applications, but also of developments in electronic techniques which could provide the best means of meeting the requirements. During 1957 this activity resulted in drawing up the specification of the Emidec 1100 system.

The initial field of work for which electronic computers were designed and built was mathematical, with a particular emphasis on speed of computation. However, before long the application of computers to commercial and clerical work was taken up, using in the first place machines originally intended for mathematical and scientific work. It soon became clear that the new field of applications differed markedly in a number of respects, but particularly in the amount and range of data to be presented to the system and processed by it, and, in many cases, the quantity and variety of results to be produced.



A general view of an Emidec 1100 system. The main cabinet contains the computing units, drum and buffer stores and control circuits for all peripheral equipment

In view of the many significant differences that affect the suitability of a system, it was realised that if a computer is to be fully effective in application, then the purpose which it is to fulfil must be carefully defined, and the resulting requirements fully assessed.

From the start, therefore, no attempt was made to compromise between the requirements of commercial applications and those of scientific or mathematical work. In determining the design and characteristics of Emidec 1100, only those factors were considered which are of significance in the field of commercial applications. This did not, of course, mean that the computer would thereby be rendered ineffective in the mathematical field, since any computer which is to be

Continued on page 35, column 2

EMIDEC *1100* INSTRUCTION

Function No.	*Function*	*Effect*
0	Halt	Cease operation and await manual restart. This function can be made conditional, according to the digits of the address in relation to the setting of switches on the monitor desk.
1	Register-Register transfer	Replace the contents of register *b* by those of register *a*, leaving register *a* unchanged.
2	Shift Left	Take the contents of register *a*, shift them by the number of places specified in *c*, and replace the contents of register *b* with this result, leaving register *a* unchanged.
3	Shift Right	Take the contents of register *a*, shift them right by the number of places specified in *c* and replace the contents of register *b* with this result, leaving register *a* unchanged.
4	Double-length Shift Left	As Function 2, but operating on registers *a* and *a* + 1, and *b* and *b* + 1.
5	Double-length Shift Right	As Function 3, but operating on registers *a* and *a* + 1, and *b* and *b* + 1.
6	Collate	Collate the contents of registers *a* and *b* and transfer the result to register 10.
7	Add	Add the contents of register *a* to the contents of register *b*, placing the sum in register *b*. The contents of register *a* remain unchanged after this operation.
8	Subtract	Subtract the contents of register *a* from the contents of register *b*, placing the difference in register *b*, the contents of register *a* remaining unchanged.
9	Multiply	Multiply the contents of register *a* by the contents of register *b* and place the product in registers 8 and 9. The contents of registers *a* and *b* are unchanged after this operation.
10	Divide	Divide the double-length number contained in registers 8 and 9 by the contents of register *a*, placing the quotient in register *b* and leaving the remainder in register 9.
11	Test Zero	If the contents of register *a* are zero, proceed to the instruction in register *b*; if not, continue with the next instruction in sequence.
12	Test Non-zero	If the contents of register *a* are non-zero, proceed to the instruction in register *b*; if not, continue with the next instruction in sequence.
13	Test Positive	If the contents of register a are positive or zero (i.e. if D35 is zero) proceed to the instruction in register *b*; if not, continue with the next instruction in sequence.
14	Test Negative	If register *a* contains a negative number (i.e. if D35 is one), proceed to the instruction in register *b*, if not, continue with the next instruction in sequence.
15	Transfer from Drum	Transfer from the drum address specified in D18–31 the number of 4-word blocks (up to 16) specified in D32–35, to registers *a*, *a* + 1, etc.
16	Transfer to Drum	Transfer to the drum address specified in D18–31 the number of 4-word blocks (up to 16) specified in D32–35, from registers *a*, *a* + 1, etc.
17	Input Block Transfer	Transfer the contents of the buffer of the input unit specified in D32–35 to 16 consecutive registers, starting at register *a*.
18	Output Block	Transfer to the buffer of the output unit specified in D32–35 the contents of 16 consecutive registers, starting at register *a*.
19	Convert Decimal Input	Take from the buffer of the peripheral unit specified in D32–35 the number of characters specified in D28–31. Convert these characters from decimal to a binary number, and place the result in register *a*.
20	Convert Sterling Input	Take from the buffer of the peripheral unit specified in D32–35 the number of characters specified in D28–31. Convert from sterling to binary pence and place the result in register *a*.
21	Alphanumeric Input	Take from the buffer of the peripheral unit specified in D32–35 the number of characters (not more than 12) specified in D28–31,

CODE

In the following notes the register specified in address a is referred to as 'register a'

Function No.	Function	Effect
		and stack in registers a and $a+1$ in 6-bit coded form.
22	Convert Decimal Output	Take the contents of register a and convert them to a decimal number. Transfer to the buffer of the output unit specified in D32–35 the number of decimal digits specified in D28–31.
23	Convert Sterling Output	Take the contents of register a and, regarding them as binary pence, convert to a sterling number. Transfer to the buffer of the output unit specified in D32–35 the number of sterling digits specified in D28–31.
24	Alphanumeric Output	Transfer from registers a and $a+1$ to the buffer of the output unit defined by D32–35 the number (up to 12) of alphabetic characters specified in D28–31.
25	Count Test	Subtract from register 7 the contents of register a. If the contents of register 7 are reduced to zero by this operation, continue with the next instruction in sequence; if register 7 is non-zero, proceed to the instruction in register b.
26	Double-length Add	As Function 7, but operating on registers a and $a+1$, and b and $b+1$.
27	Double-length Subtract	As Function 8, but operating on registers a and $a+1$, and b and $b+1$.

Operating Speeds

The speeds at which the Emidec 1100 performs individual program steps may be assessed from the following summary of the times required for each function; in every case the time stated is from the start of the relevant instruction to the start of the following instruction.

FUNCTION	*TIME*
Add, Subtract, Collate, Transfer	150 microseconds
Multiply	1260 ,,
Divide	1450 ,,
Shift Left or Right	165–400 ,,
Test Functions	125–225 ,,
Drum Transfers	16-38 milliseconds
Peripheral Unit Block Transfers	1200 microseconds
Input Conversions	260–1100 ,,
Input Alphanumeric	330 ,,
Output Conversions	3000 ,,
Output Alphanumeric	290 ,,

The above times include access times, for example, in the case of the arithmetic operations three access times are involved, two for the sources and one for the destination. The time for any instruction modification is also included.

effective over a sufficiently wide range of commercial work will still retain the basic characteristics necessary for mathematical work. It was not so much a direct choice between separate and differing facilities as a change in emphasis that was required.

In determining the requirements that would need to be met by a computing system which was to have the widest possible range of applications in the commercial field, it was clear that the detailed attributes of the system were of far less moment that its general qualities. Although it is still quite common to attempt a comparison of machines by tabulating their specification details, such a comparison has little real value, since it in no way relates the machines to the applications on which they will be deployed, and the variation from application to application can be so large as to make the assessment meaningless. Thus the first step was to determine the general qualities to be expected of a computer whatever the application it was to be deployed on.

Although even here it is impossible to assign to these qualities any order of significance, a number were considered essential:—

1. *Reliability*. The particular characteristic of electronic computers which has over the years received the greatest publicity is without doubt their speed of operation. Their first use on mathematical work made possible the solution of problems which would otherwise have taken years. However, this very advantage has meant in many cases that no rigorous demands needed to be made on a computer with respect to the time-scale within which a job was completed: if results were available in two weeks instead of one, they were still often as valuable, and in any event had been produced immeasurably faster than would have been possible by any other means.

In a commercial application, however, this is by no means so: results must be produced according to a weekly, daily or even hourly timetable, and departure from that timetable must often be classed as complete failure.

It was thus clear that a primary aim in designing Emidec 1100 had to be a far higher order of reliability than had previously been envisaged.

It is unfortunate that there is still a very frequent confusion between reliability—that quality which enables a computer to operate correctly, and to continue to operate correctly over long periods—and checking—the applying of measures to detect failures, and, in a proportion of cases, to correct them.

By the standards which the team set itself, the pursuit of checking devices rather than true reliability would have been a confession of failure.

TABLE II

Emidec 1100 Special Registers

Register No.	*Use*
0	Constant source of zero
*1	Modification registers
*2	Modification registers
*3	Modification registers
*4	Modification registers
*5	Modification registers
*6	Modification registers
*7	Modification register and count-test
*8	Product and dividend register
*9	Product and dividend register
*10	Collate register
11	Constant Source: Digit 0
12	" " " 8
13	" " " 18
14	" " " 28
15	" " " 35
16	Monitor desk As source, switches on monitor desk. As destination, indicator lights on monitor desk.

In fact checking facilities are applied at certain points in the Emidec system, but only as an additional safeguard, and never as a substitute for the reliability that is essential.

2. *Simplicity.* A computer is of necessity a complex instrument, and the general tendency is to become resigned to increasing complexity, and even to espouse it as a desirable end in itself. But in any system planning it is a commonplace that the best systems are simple systems; because of the inherent complexity of computers, it is essential to remember this. Thus in the development of Emidec 1100 it was determined that at no point where it could be avoided would the computer be so designed as to impose complexities on the user.

Thus it was decided that although time-sharing of buffers would have reduced machine costs, the consequent complication of the system was a disadvantage that considerably outweighed this reduced cost; again, facilities for addressing magnetic tape information can give occasional advantages, but these advantages are insignificant compared with the loss of simplicity that they involve. The instruction code is less extensive than many, and deliberately so; nevertheless, it has been found in practice that it is sufficient for its purpose, and, by its restraint, helps to make the programming of the machine simple and straightforward.

3. *Flexibility.* Since Emidec 1100 was intended to cover the whole range of commercial work, it had by nature to be flexible. However, for a particular user, it is hardly of interest that, had he had a different application, he might have used the same machine. But even in this case flexibility is of paramount importance, since it is a characteristic of clerical work that it is always changing, developing and expanding its scope to keep pace with the business of which it forms an integral part, and a computer which is to continue to be effective must permit such changes to the greatest extent. Thus the buffer system of Emidec 1100, in which each peripheral unit is provided with its own separate buffer system enabling it to function independently of all others, not only provides complete flexibility in the choice of an initial configuration of equipment to suit the application, but allows also for its modification and extension as the application changes or expands.

4. *Extensibility.* As a further aspect of flexibility, it was recognised that constant developments must be expected, not only in the applications for equipment available, and especially in the peripheral equipment (input, output and storage). So it was decided to facilitate the incorporation into the system of any such new equipment as it became available, or the addition of further existing units as they were required. To a great extent therefore the danger has been overcome that a business might outgrow its computer through inability to extend its capabilities.

5. *Balance.* This quality is perhaps the most difficult of all to define, and yet one of the most essential. The rate at which computing speeds have increased during the last ten years has been high, and may be expected to climb higher still. However, an increase in the internal computing speeds of systems is of little practical value in commercial work unless it results in an increase in the over-all system speed (and not always then). It is important that the system should not be limited significantly by its computing speed, even taking into account the probable increase in input-output speeds, but in fact the general design of Emidec 1100 is such that while the computing speed is fully sufficient for this purpose, the balance has been maintained between the central computer and its peripheral units.

THE SYSTEM'S MAIN FEATURES

In order to meet the requirements reviewed above, the system has been designed round a computing centre, which consists of an Arithmetic Unit, Control Unit and a 1,024-word immediate access store, which is supplemented by one or more magnetic drum stores. For each application, this centre can be arranged to work with a wide range of input and output units, including magnetic tape decks, the precise conformation of which is determined by the needs of the application.

In order to achieve the necessary standard of

reliability, magnetic cores and transistors have been adopted as the basic circuit elements, to the almost complete elimination of valves, with their limited life characteristics. In addition very wide facilities are provided for monitoring and testing to enable the equipment to be kept at a very high state of reliability over long periods.

The Computing Centre operates at a clock rate of 100 Kc/s, with parallel operation on words of 36 bits (sign bit + 35). Each word can in fact represent a 36 bit binary number, a program instruction, or a group of six alphanumeric characters, and facilities are provided for operating on each type of information.

The Arithmetic Unit which includes a number of high speed special purpose registers for the performance of all automatic functions, will carry out the transfer addition, subtraction, shifting multiplication, division collating and testing of 36 bit numbers, and for transfer shifting, addition and subtraction of double-length (72 bit) numbers. Full provision is also made for automatic conversion of numbers to and from sterling or decimal notation—a facility of great significance in commercial applications.

A full list of the functions which can be specified in programming is given in table I, with their over-all operating times (including all store access times).

The Control Unit is responsible for the initiation of the operations defined in the program in their correct sequence. The use of a magnetic core matrix to drive the control signals appropriate to each function not only achieves economy and simplicity of equipment, but also contributes to ease of testing and maintaining the equipment.

The Immediate Access Store is provided by a magnetic core matrix consisting of 1,024 registers of which all except 17 are available without restriction for the storage of program instructions or data, or as an accumulating register.

Of the remaining 17 registers, nine are of the same type, but with additional special facilities, six function as sources of widely used constants, and two provide monitor desk facilities. Details of these registers are given in Table II.

Large-scale Magnetic Drum Storage is provided by up to four drums, each of 16,384 words capacity, arranged in 256 tracks each of 64 words. Track selection is by electronic switching, and transfers of data between a drum track and the core store are made in multiples of four words, up to a complete track of 64 words.

Although in general the transfer times involved are sufficiently rapid to enable the computer to function very effectively, a backing store of 4,096 words on magnetic cores can be provided either in place of or in addition to magnetic drum storage.

PERIPHERAL EQUIPMENT

Provision has been made for the input of data from punched tape (5, 6 or 7 hole), punched cards (65 or 80 column) or one-inch magnetic tape, and for output of results by way of magnetic tape, line printer, paper tape punch, or card output punch.

In all cases, each peripheral unit is provided with its own double buffer store and control circuitry. This enables the peripheral unit to be working to one of the buffer stores while the other is available to the computing centre, so that each channel can work independently of the computing centre. On the other hand, transfers between the buffer systems and the computing centre are dealt with serially at high speed, and the complexities of parallel programming are avoided.

An important feature of the buffer system adopted is that it allows for optional off-line working without special equipment. Thus in a system which includes a number of magnetic tape units, all tape units may in one part of the work be used for on-line working, with a printer also working on-line, while in another part of the work the line printer buffer may be connected directly to the buffer of one of the tape units to work as an off-line printer, independently of the rest of the computing system, to print information previously recorded on tape. Similarly, off-line input can be achieved by directly connecting two buffer systems.

TABLE III

Input/Output Equipment

	Medium	*Unit*	*Maker*	*Speed*	*Buffer storage (characters)*
Input	5-, 6- or 7-hole paper tape	Photo-electric tape reader	Ferranti	300 chars. per sec.	2 × 12
	65- or 80-column punched cards	Photo-electric card reader	Elliott	400 cards per min.	2 × 99
	Magnetic tape	FR3 High-speed tape deck	Ampex	8,000 chars. per sec.	2 × 198
Output	Printed copy	Samastronic line printer	ICT	300 lines per min.	2 × 99
	Punched cards	Card punch	ICT	100 cards per min.	2 × 99
	Paper tape	Type 25 tape punch	Creed	30 chars. per sec.	99
	Magnetic tape			As above	

Up to 16 peripheral units can be directly connected to the Computing Centre, and within this there is no limit upon the selection of units for a particular installation. Table III gives some details of the operational characteristics of the standard peripheral units which can be employed in the Emidec 1100 system, although it should be borne in mind that the design of the system is such that the introduction of other equipment is quite possible.

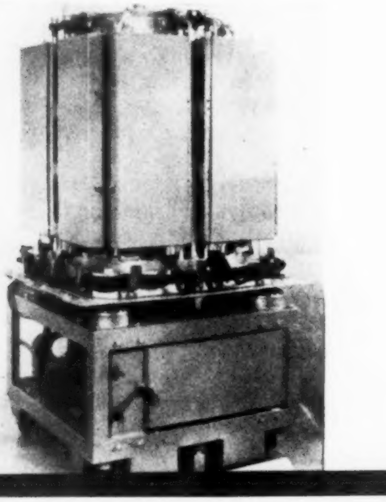
MAGNETIC TAPE UNITS

In the Emidec 1100 system, each tape channel incorporates an Ampex FR 300 high speed tape transport, which can be used for either reading or recording information on 3,600-ft. reels of one-inch wide magnetic tape. Each channel operates independently of the others, with program facilities for the selection of reading or recording and automatic rewinding.

The tape is run at a speed of 150 inches per second, with a start/stop time of less than 1.5 milliseconds. The density of information is 133 bits per inch, and since information is recorded in parallel on six tracks, the basic transfer rate is 20,000 characters (six bits) per second. Recording is in blocks of 198 characters (32 words), and a half-inch gap is left between each block; but since alternate blocks only are read or written in one direction (the other being read or written in the return direction), the effective transfer rate in continuous processing is 8,000 characters per second.

The main object in designing the tape system was the highest standard of reliability, and although odd parity is applied to every character, with an indication of failure automatically transferred to the computer, this is considered only as an extra safeguard. Of considerably more importance is the fact that all information tracks are duplicated on the tape; by this means it is possible to ensure not that incorrect information is detected, but rather that it is avoided.

A magnetic drum store which holds 16,384 words



PROGRAMMING CHARACTERISTICS

The instruction code of Emidec 1100 is of full two-address type, in which, for arithmetic and logical instructions any two locations of the immediate access store can be specified. Thus in effect every location (with the exceptions noted in Table II) is an accumulator, allowing the greatest flexibility in deploying the storage. Similarly, transfers of information can be made between any part of the drum storage and any part of the core store.

Each instruction occupies one 36-bit word, the digits being allocated as follows:

Digits 0 – 2	:	Modifier
3 – 7	:	Function
8 – 17	:	Address 'a'
18 – 27	:	Address 'b'
28 – 35	:	Address 'c'

This code allows for 32 functions, of which 28 have so far been allocated as shown in Table I. The addresses *a* and *b* are in most cases used to specify the locations containing the operands (for drum transfers the *b* address in fact extends beyond digit 27, although no account need be taken of this in programming), and the *c* address further to define the operation (*eg.* to define the extent of a transfer operation).

The modification number directly specifies the register whose contents are to be added to the instruction before it is executed. Since register 0 is a constant source of the number zero, there is thus provision for seven modifying registers which are, of course, provided with full accumulator facilities.

Programs are written in a single decimal code, with a comprehensive relative addressing system which allows the fullest flexibility in building up the large-scale programs necessary for commercial applications. The programs are in the first instance recorded on either punched cards or punched tape, and under control of an Emidec synthesis program are translated into full binary form to be recorded on magnetic tape for operational use.

MONITORING—AND OPERATING FACILITIES

The monitor desk of Emidec 1100, illustrated here, has been designed to provide a simple but fully adequate array of facilities for engineers, operators and programmers. It enables the contents of any part of the storage to be examined and, if necessary, modified; gives clear indications of any operating action that is required by the system; and provides the means of rapidly applying general marginal checks to all parts of the system.

New Transistorised Computers

IBM recently announced a transistorised development of the IBM 705, which can process work six times as fast as any previous IBM commercial computer, but at substantially lower cost per job. The new computer is the IBM 7080, capable of 303,000 logical decisions a second. Addition can be performed in 12 microseconds and multiplication in an average time of 140 microseconds. The machine can read from, or write into, magnetic tape at a speed of 312,000 characters per second: this it achieves by operating on five magnetic tapes simultaneously at a speed of 62,500 characters per second on each tape, while also performing internal computations and the transfer of data.

The main storage of the IBM 7080 consists of one or two units of magnetic core storage, each with an access time of 2.18 microseconds and a joint capacity of 160,000 characters. The auxiliary storage, with an access time of 1.09 microseconds, has 1,024 positions.

Existing programs for the IBM 705 can be performed on the IBM 7080, which also has 15 additional instructions which can be used in new programs. These enable the machine to perform two independent programs simultaneously.

Card readers, punches and printers for the IBM 705 can be used with the IBM 7080, together with up to 50 magnetic tape units.

The system requires only half the air conditioning and power required for the IBM 705 and about 70 percent of the space, which can be further reduced by using the IBM 1401 for off-line printing.

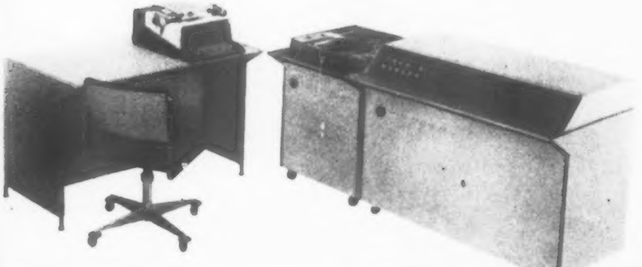
A NEW transistorised computer is also announced by the British sales organisation of Royal McBee. Their RPC-4000 has a memory of 8,008 words which can be scanned at a sustained speed of nearly 200,000 words per minute and incorporates a special masking feature that makes it possible to scan partial words at the same rate. The computing system is capable of operating on nine-digit numbers at the rate of 240,000 operations per minute.

The standard input-output equipment is a tape typewriter system, complete with typewriter, desk and punch-read console, all designed as one unit. The basic reader speed is 60 characters per second, the basic punch speed 30 characters per second.

The RPC-4000 can select automatically any one of 17 input devices and one or more of 17 output devices. With minor modifications, the number of input-output devices can be increased to 60. Optional accessories for expanding the system include a reversible photo-electric reader which reads punched paper tape at 500 characters per second and a highspeed punch that reads 300 characters per second.

The basic system weighs about nine hundredweight and can be connected to a standard 230-volt electricity supply. No special building alterations are necessary for installation. Dependent upon the amount of accessory equipment, the cost of the system varies between £40,000 and £100,000.

Below: Royal McBee's new computer—the RPC-4000—which has a memory of 8,008 words.



Aspects of Management

A SERIES of four lectures is to be given under the auspices of the Institution of Works Managers at the Midland Hotel, Birmingham, on 27 April,

4 May, 11 May and 18 May. The lectures will be delivered during the evenings, and the fee for the course is four and a half guineas. Applications may be made to W R Pickering Esq, The Welded Steel Tube Company Limited, Wednesfield, Staffs.

The course has been designed in consultation with the conference organisation of Business Publications Limited to deal with some of the most vital current problems of business management. The speakers and their respective subjects are: Frank A Heller, BSc, Head of the Department of Management Studies, Regent Street Polytechnic, London (The Significance of Company Structure); George Copeman, PhD, Director of Business Publications Limited (Executive Pay and Promotion); Group-Captain F C Daubney, CBE, Managing Director of Creed and Company Limited (The Nature of Executive Authority); and Professor J V Connolly, Director of Sundridge Park Management Centre (The Development of Executive Morality).

Automation and Poetry

CORNELL UNIVERSITY, in the United States, has recently published a concordance of the poetic works of Matthew Arnold. The volume, of 965 pages, containing 70,000 references, was 'punched out by an IBM system,' says *Newsweek* of 29 February, in 197 hours.

This is contrasted with the Cornell concordance of William Wordsworth's poems, published in 1911, after 67 scholars had been at work on it for six years. (See 'Automatic Literary Analysis,' in AUTOMATIC DATA PROCESSING of November 1959, for an account of the mechanical preparation of a concordance of the *Summa Theologica* of Saint Thomas Aquinas.)

EMI Sales Agreement

AN agreement aimed at greatly increasing the sale of British electronic equipment in the United States was announced in London and New York during February. Under this agreement, the Fairbanks Whitney Corporation of New York has undertaken to market most of the electronic equipment designed and manufactured by EMI Electronics Limited.

Among the EMI products that will now be fully exploited in the United States market are the Emidec computers and data processing systems, analogue computers, and other electronic control and automation systems, including closed-circuit television. Fairbanks Whitney will also manufacture some products under licence.

The agreement is reciprocal: certain equipment developed by the American company will be marketed in Britain and Europe by EMI.

COURSES AND LECTURES

25 April to 3 June
Management Practice and the Systems Analyst
Organised by Production Engineering Ltd
Venue: 12 Grosvenor Place, London, SW1
Enquiries to: Courses Secretary, Management Training (PE) Ltd, Park House, Wick Road, Egham, Surrey.

28 April
Symposium on 'Auto Codes'
Organised by The British Computer Society
Venue: Small Shanlon Lecture Theatre, University College, Cardiff
Enquiries to: Mervyn Thomas, Esq, 4 Park Road, Hengoed, Glam.

2 May
Programming course on the Stantec Zebra Computer—normal code
Organised by Standard Telephones & Cables Ltd
Fee: 40 guineas
Venue: Newport
Enquiries to: Corporation Road, Newport, Mon.

6-8 May
Introductory weekend computer course
Organised by The Institute of Cost and Works Accountants
Venue: Whirlow Grange, Sheffield.

9 May for three weeks
Course on the Business Application of Computers
Organised by Computer Consultants Ltd
Fee: Five guineas a day
Enquiries to: Computer Consultants Ltd, Cecil Court, London Road, Enfield, Middlesex.

27-28 May
Conference on 'The Computing Laboratory in the Technical College'
Organised by Hatfield Technical College
Venue: Hatfield Technical College
Enquiries to: Head of the Mathematics Department, Hatfield, Herts.

6 June for three weeks
Computer course on the Emidec 2400
Organised by EMI Electronics Ltd
Fee: 50 guineas
Venue: EMI Electronics Ltd, Hayes, Middlesex.

4 July
Programming course on the Stantec Zebra Computer—simple code
Organised by Standard Telephones & Cables Ltd
Fee: 15 guineas
Venue: Newport
Enquiries to: Standard Telephones & Cables Ltd, Corporation Road, Newport, Mon.

11 July
Programming Course on the Stantec Zebra Computer—normal code
Organised by Standard Telephones & Cables Ltd
Fee: 50 guineas
Venue: Newport
Enquiries to: Corporation Road, Newport, Mon.

26 September-7 October
Non-residential Summer School on Numerical Analysis for users of digital computers in industry, government and university departments
Organised by: Oxford University Computing Laboratory
Fee: £30
Venue: Oxford
Enquiries to: Secretary, Delegacy for Extra-Mural Studies, Rewley House, Wellington Square, Oxford (before 1 June).

ACCESSORIES

For Tapping Information Sources

THE American Friden Company have produced equipment for transmitting data on punched cards to a central receiving point. Mention was made last month in these notes of the IBM 357 system, while the Stromberg system was extensively described in 'American Report'—both these systems are designed to permit the rapid transmission of information from factory, store or branch to a processing centre—as indeed is Friden's equipment which has been labelled the 'Collectadata' system.

Bulmers, who market Friden's products in this country, have begun advertising Collectadata, so now—with the IBM 357 equipment—two systems for collecting data are available in Britain.

Basically, Friden's Collectadata comprises a number of units which will read and transmit data on edge punched cards, or conventional punched cards (additional numeric data can also be transmitted by adjusting 18 dials) to a receiver—an eight-channel tape punch.

The receiver can accept data from multiple transmitters through a common cable (which must contain a minimum of 14 conductors). Actual wire size, distances and the number of sending units to one receiver will vary with individually devised systems.

Each Collectadata receiver can be connected to a time code emitter—a device which will read out a five-digit time indication automatically as a transmission begins. The need for a time code emitter might arise in production control applications where the time factor was all-important.

A paper tape is the end-product of the Collectadata transmission system. Friden anticipate that this might then be used in a tape-to-card converter to produce punched cards, but also Friden obviously have their eye on the possible use of paper tape in their Flexowriter machines, quite apart from the fact that the tape might be used as a computer's input.

Bulmers (Calculators) Ltd,
47-51 Worship Street,
London, EC2.

Face Lift for Cards

A MACHINE which reconditions damaged cards has been developed by the Cummins Chicago Corporation. Known as the 'Carditioner,' this machine can handle about 275 cards a minute and it is claimed that it will recondition some 83 percent of otherwise unusable cards.

It will restore edges, flatten warped cards, iron out creases, while preserving exact original dimensions and sorting out those cards to which tape or staples are attached.

A small machine (it measures 40 inches by 16 by 12 inches), it is very simply operated by pushing a button. K S Paul (Printing Machinery) Ltd are the distributors for this machine in Britain.

K S Paul (Printing Machinery) Ltd,
Great Western Trading Estate,
Park Royal Road,
London, NW10.

Brisk Reading

THE latest development in electronic reading machines is a device which is capable of reading typewritten pages and translating what it reads into electronic pulses at the rate of 200 characters a second.

Embodying a scanner which produces video impulses from the characters of a page of type and which identifies the 'pattern' of each character, the machine can distinguish between upper and lower case alphabetical characters, numerals and punctuation marks.

The output from this print reader can be punched on to paper tape or cards registered on magnetic tape or transmitted directly into an electronic computer. It might be possible to use such a reader to work automatic typesetting machines.

Work is still in progress on this reader, which was developed by technicians of the US Air Force and the research department of Farrington, as it can at present read only one style of type.

The Farrington Manufacturing Co,
Alexandria,
Virginia, USA.

For Solving Differential Equations

SUGGESTIVE of a model built with an adult's Meccano set, this is very much a non-electronic computer. It has been built from elements of the Weyco Fac construction system, and is capable of solving differential equations. It qualifies for the label of 'do-it-yourself computer,' as the rods, beams, gears and bearings can be dismantled easily and used again.

Weyco Fac kits—there are two, classified as X1 and X2—are priced at £49 10s. and £86 respectively. (Nearly 5,000 parts are included in the X2 kit.)

Weyco (Sales) Ltd,
18-20 Dames Road,
London, E7.

NOVANO PRE-WIRED PLAQUES

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Novano System

The Novano Pre-Wired Plaque System provides a remarkably simple alternative to the 'fixed' plug boards used in many punched card installations.

Flexibility in operation, ease in storage, and economy are three advantages of the Novano system, now adopted by many well-known firms with extensive tabulating machine installations.

An examination of the Novano system may suggest its economic employment in the interests of added efficiency in your installation. Enquiries will be welcomed by the sole U.K. concessionaires and consultants:

Punched Card Accessories Ltd., Abbey House, Victoria Street, Westminster, London, S.W.I.
Telephone: ABBey 2691-3

Novano is a product of Novotechnics Ltd., of Letchworth, Hertfordshire.

Photograph by courtesy of 'B.P.'

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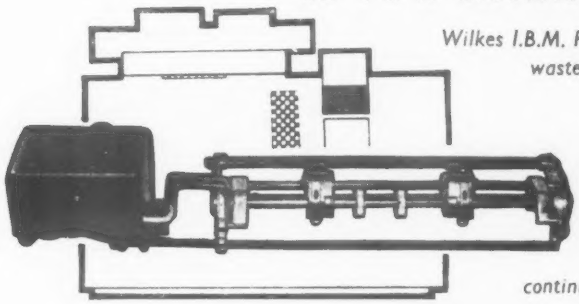

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SPECIALISTS IN CONTINUOUS STATIONERY AND BUSINESS FORM SYSTEMS

'IMAGINATIVE' USES FOR COMPUTERS

continued from page 32

examples of the possibilities in inter-company data processing. Under the active sponsorship of the Air Transport Association of America, large segments of the industry have agreed upon uniform 'machine language' purchasing procedures in place of the unwieldy variety of forms previously in use.

To airline managements, this means more efficient purchasing operations, better inventory control, and reduced parts delivery times. To the manufacturers supplying them, it offers a single way of doing business with airlines.

The Air Transport Association's Specification No. 200, entitled 'Specification—Integrated Data Processing—Supply' outlines a standard method of processing purchase orders and related documents through various media of transmission, such as punched cards, magnetic tape, teletype, etc. Other portions of the specifications will be forwarded to holders of the specifications as they are developed.

While the standard system is designed primarily for use between airlines and suppliers who use integrated data processing equipment, care has been taken to ensure compatibility with the systems of airlines and suppliers not utilising such equipment. The specification may be implemented by an airline and supplier at a mutually agreeable effective date. Before activating the standard system, the airline and supplier enter into a general terms agreement, or other agreement, which outlines the terms and conditions of procurement and reflects the requirements of the specifications as part of the contractual arrangements.

For the carriers adopting it, the inter-company system means the elimination or reduction in use of such traditional ordering documents as the quotation request, purchase order, order acknowledgement, charge order, packing sheet, invoice, sales order, receiving form, and others.

In their place is a series of five IBM punch cards, each colour-coded to signal its particular rôle in the system, and each having its own special format agreed upon by airlines and manufacturers after a series of some ten major meetings extending over a period of a year.

Even the airlines having no tabulating devices will benefit from this standardisation. The manufacturer, to facilitate his internal processing, will use their conventional purchase order as a source document to record the order in the standardised punched card form.

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RATES: APPOINTMENTS VACANT, 3s. 6d. per line (minimum 3 lines), 40s. per display panel inch. APPOINTMENTS WANTED, 3s. per line, 35s. per display panel inch. Box No. charge, 1s. extra. Address advertisements to The Classified Advertisements Manager, "Automatic Data Processing," 109-119 Waterloo Road, London, S.E.1. Tel.: WATerloo 3388 (Ext. 32).

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(2) To work with a group on theoretical study of high temperature plasmas using IBM 704. Aptitude for computer programming is more important than familiarity with plasma physics; applicants should be qualified in physics and mathematics; some relevant experience preferable. Applicants should have G.C.E. at "A" level, H.N.C. or equivalent.

Salary: £510 (at age 20) to £905 p.a. or £1,045 to £1,285 p.a. according to experience.

Housing and pension scheme.

Please send a POST CARD for application form to: Group Recruitment Officer, (1629/297), U.K.A.E.A., A.E.R.E., Harwell, Didcot, Berks.

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